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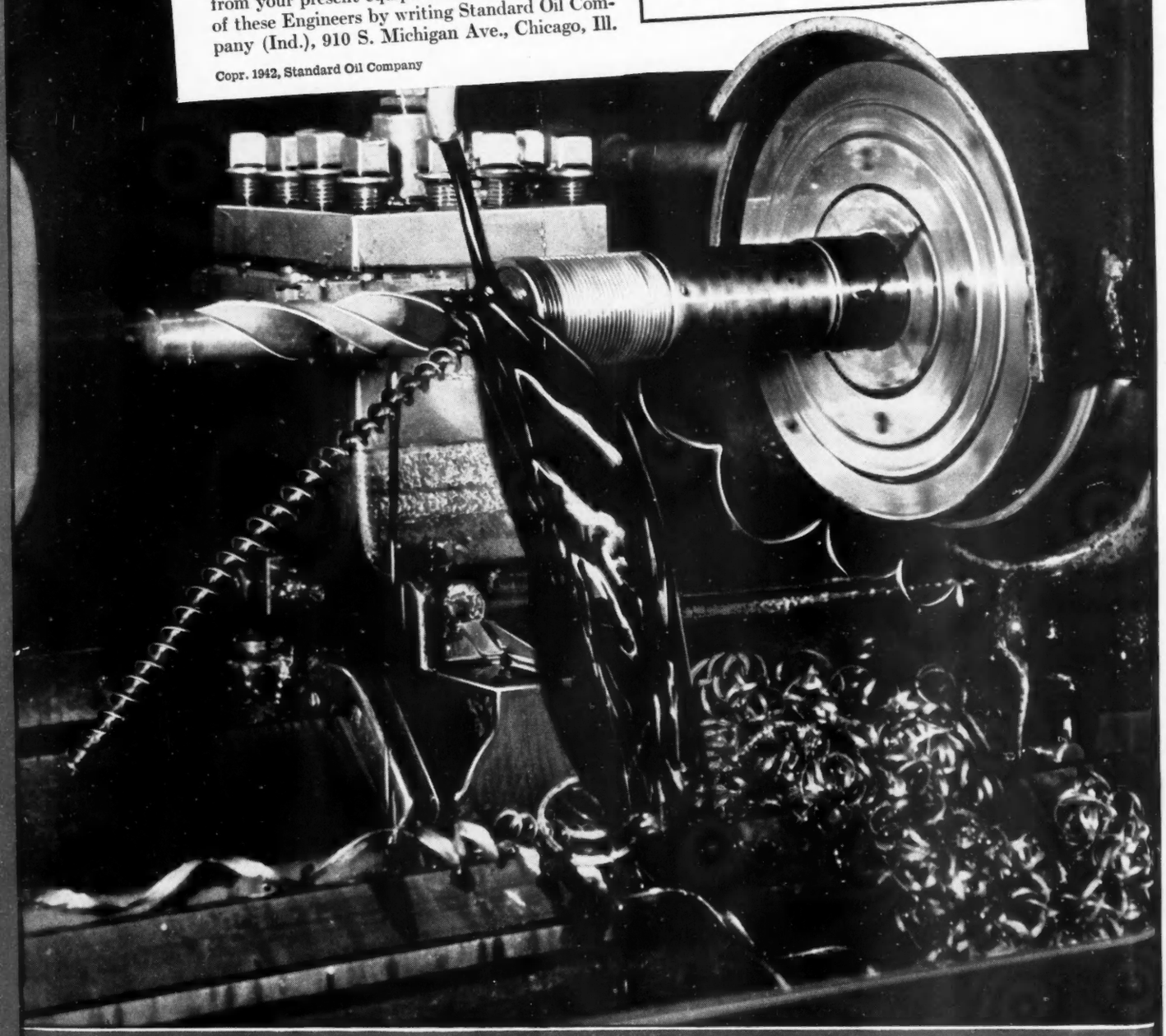

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Published Semi-Monthly

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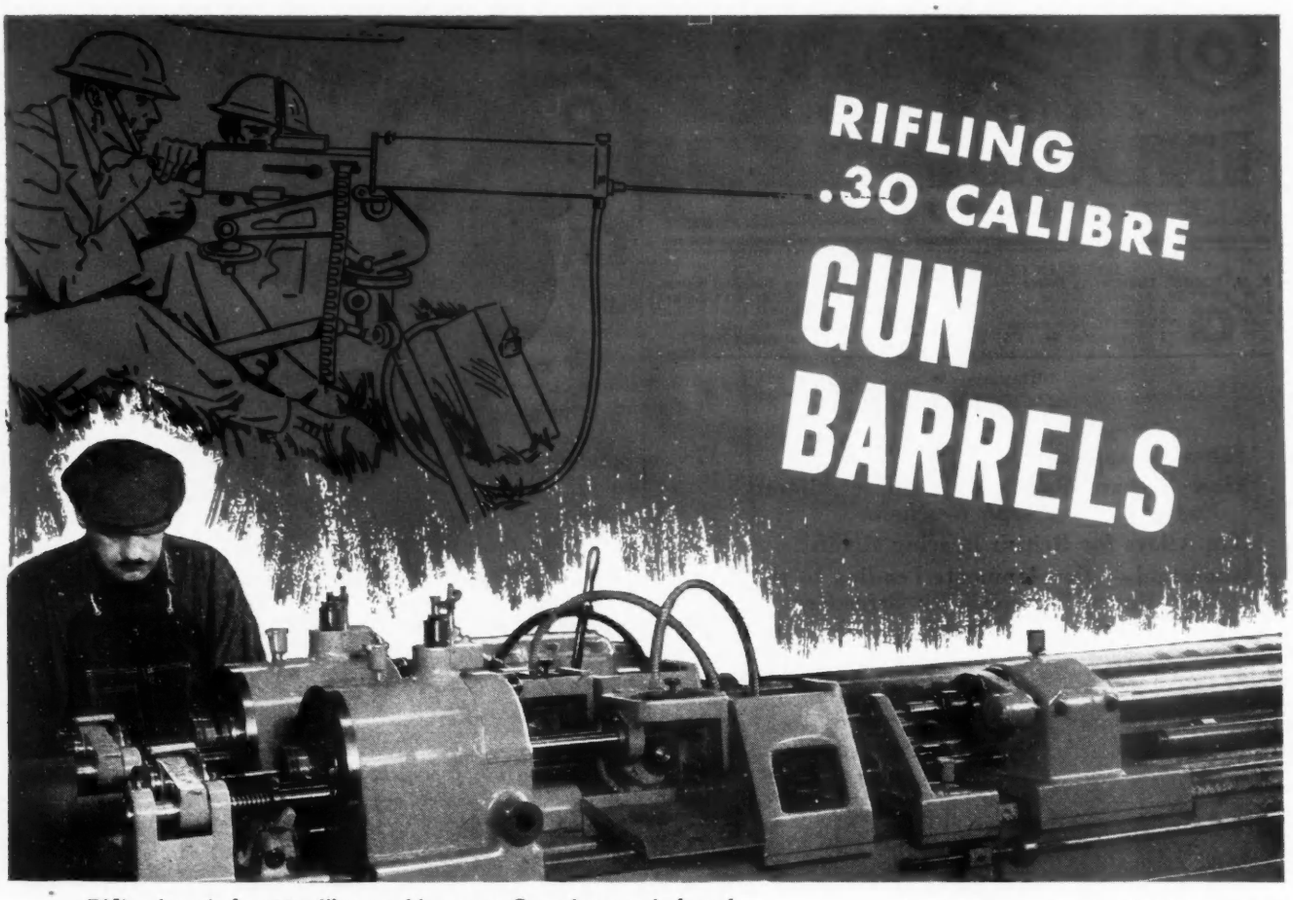

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IN THIS ISSUE . . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 86 May 1, 1942 Number 9.

Silver's Importance 17

Not long since silver was looked upon as anything but an industrial metal. Almost over night it has climbed into a front line position. What has happened in the production field to bring this about is told in this authoritative article by an author who knows.

How Packard Builds Rolls-Royce Engines 20

The building of aircraft engines is very much different from building automobile engines. The application of mass-production methods at the Packard plant in the manufacture of the Rolls-Royce aircraft engines has been one of the outstanding accomplishments in the war program. Read about it. You must.

Supertanks 26

The problems of the military tank designer are to balance many conflicting elements. They are indeed many as well as conflicting. In this article General Barnes brings many of them out into the open and explains the "hows and whys."

Designing of Six-Wheel Trailers 30

This article is an analysis of the problems incident to the designing of brakes for heavy vehicles. Comparisons are made of the different types and the authors have carried everything to the last "common denominator." It is highly enlightening.

Steel and Wood Design for Training Planes 34

In this progressive design 75 per cent, by weight, of aluminum alloys have been eliminated. The savings of aluminum in building 1000 of the trainers will be sufficient for the production of 420 pursuit planes. All of this with no appreciable added weight or sacrifice of strength.

Allison Testing Facilities 38

In this presentation some innovations in testing equipment are shown and explained. Revealing illustrations show them and copious captions explain them.

AUTOMOTIVE INDUSTRIES

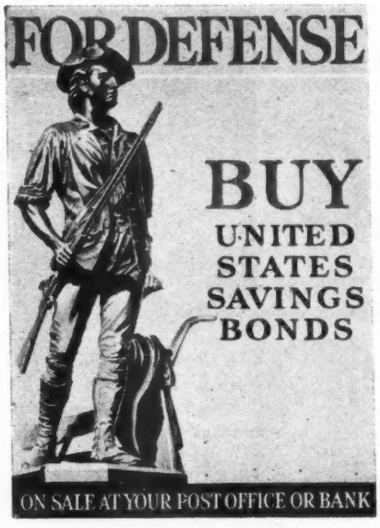
Reg. U. S. Pat. Off.

Highway Barriers To Be Investigated

The Senate Defense Investigating Committee will conduct an inquiry soon into transportation bottlenecks, Senator Harry S. Truman of Missouri, chairman of the committee has announced.

Senator Truman said the committee planned to call Director Joseph B. Eastman, of the Office of Defense Transportation, as one of the witnesses on all phases of the mounting problem and it is anticipated that other highway experts also will be invited to testify before the committee, which will hear only invited witnesses.

The U. S. Department of Commerce in "A Brief Report on the Effect of State Laws Which Create Barriers to Interstate Motor Transportation on the National Defense Program," revealed that hundreds of truck shipments to aircraft factories, shipyards, cantonments, and war supply depots have been delayed unnecessarily by restrictive state laws imposed upon highway transportation.



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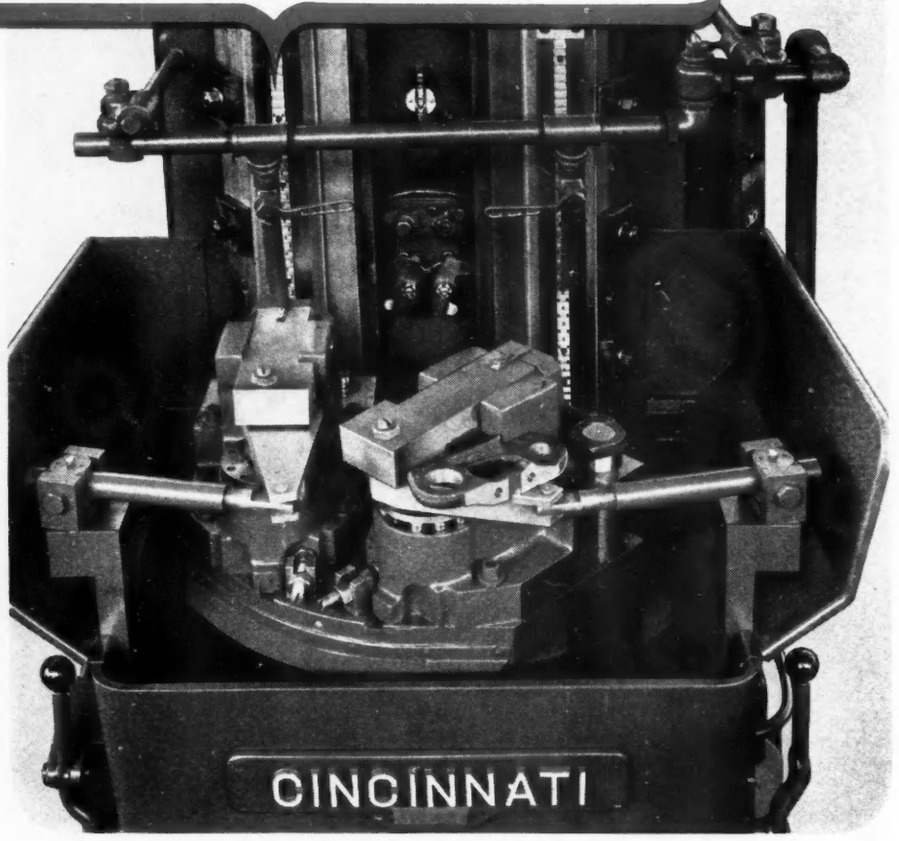

MULTIPLY the expected production of tanks by 300 to 400, and you have an idea of the output required of many of the track mechanism parts. The track link lying on the above broaching fixture falls within this group.

As with all war-time materiel, speed of production of these parts is paramount, and a high rate of production can be obtained on this CINCINNATI No. 2-48 Duplex Hydro-Broach.

Because of the automatic clamp and release feature (it eliminates the majority of operating effort) almost anyone can run the machine.

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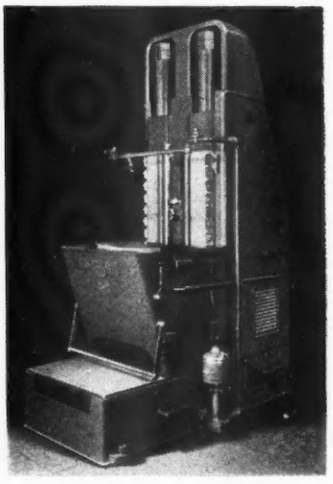

CINCINNATI No. 5-42 Duplex Vertical Hydro-Broach Machine. Complete description and specifications given in catalog M-894.

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Published on the 1st and 15th of the month

Vol. 86, No. 9
May 1, 1942

Silver's Importance—

Its Many Applications and Future Possibilities in Automotive and Aviation Fields Are Revealed in This Article by Metals Authority

By W. C. Hirsch

SILVER, not so long ago looked upon as a precious coinage metal with but few more practical uses than gold, has begun to take its place by the side of the other important non-ferrous metals as a vital industrial material. In the last three years silver sales to manufacturing plants in the engineering industries have registered a steady increase, a conservative estimate being that they have tripled in that time. Of this growth in consumption a preponderant share came from the automotive and aviation industries.

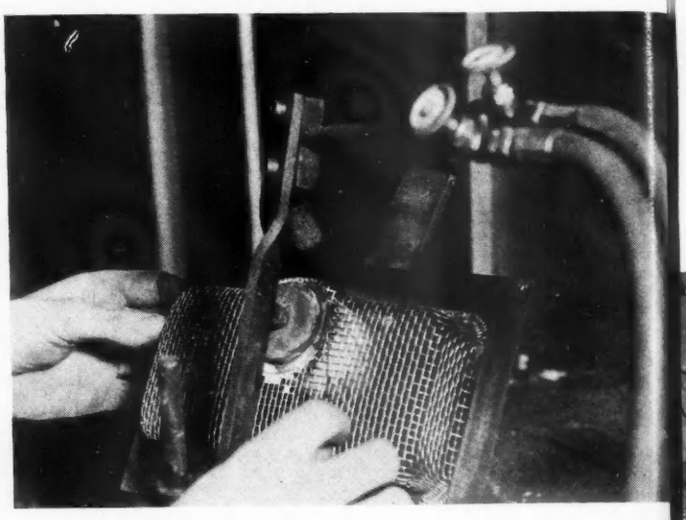
Expansion in the use of silver in airplane assemblies and aeronautical applications generally was marked even before the loss of the Malay States and the Dutch East Indies. It would, therefore, be an error to ascribe the increase in the demand for silver brazing alloys entirely to the diminished availability of tin for these compositions.

These silver brazing alloys possess certain properties, which are now becoming better recognized and, as a result, induce a steadily widening range of applications. It also should be noted here that a large amount of silver in the form of anodes goes into giving automotive and airplane parts a protective coating and in some cases a decorative plating. Its uses in brazing alloys, however, appear to come in for special interest at this time.

Silver brazing alloys consist chiefly of copper and silver with zinc, tin, cadmium, and a deoxidizing agent like phosphorus entering into some of these compositions to a varying extent. Their melting point ranges from 1200 to 1600 deg. Fahr., which is below the range of base metal brazing alloys. This relatively low melting point, combined with their ductility and malleability as well as their resistance to corrosion and the yielding of strong joints, offsets the higher first cost. It is emphasized by the manufacturers of these solders that very thin layers suffice and that, therefore, actual cost per joint will in many uses be less than if base metal alloys are employed. Besides resistance to shock and vibration, their low melting point endows silver brazing alloys with a large measure of protection against overheating of the metal and alloys to be joined and affords labor and fuel economies because of the shorter

Silver alloy is being used for the brazing operations on this brass radio shield, which is intended for covering the wiring harness of an aircraft engine.

Courtesy of Handy & Harmon



Brazing a binding ring with a silver alloy to a stainless steel air screen for an airplane carburetor scoop.

Courtesy of Handy & Harmon

time required for the heating of joints.

While the range of the silver contained in these brazing alloys runs from 5 to 80 per cent of silver, the silver content of those in widest use is no more than 50 per cent, frequently less. A proprietary alloy, Sil-Fos, consists of 15 per cent silver, 80 per cent copper and 5 per cent phosphorus. It melts at 1300 deg. Fahr. and is used extensively for the joining of copper and copper alloy parts. Another proprietary alloy Easy-Flo contains 50 per cent silver and melts at 1175 deg. Fahr., being used for joining ferrous as well as non-ferrous metals and alloys. Silver brazing alloys are available in a wide range of sizes of strip and wire.

The Army Air Corps and Navy Bureau of Aeronautics specify the use of silver brazing alloys in many diversified applications. Work of this type must conform to certain U. S. Navy, Federal, or Society of Automotive Engineers—Aeronautic Materials Specifications. Brazing flux must also conform.

Perhaps the most interesting application of silver brazing alloys in airplane assemblies is in the joining of oil coolers and radiators. Brazing alloys are used for joining the outer shell to the inner shell and for inlet and outlet connections. A method has been developed for the use of silver brazing alloys in joining the tubes which make the core assembly in a new type of cooled radiator. A good deal of silver brazing alloy is used for the joining of the various parts that make up the ignition system of radial type engines. On one engine of this type there are more than half a dozen brazed joints in the shielding ring and more than a score on the spark plugs. Electrical connections and shielding, piping connections on fuel and oil lines furnish points for the use of silver brazing alloys as does the fabrication of parts and accessories, instruments, cables tubes and frame arresters. Carburetor parts, floats and fuel pumps, propeller parts, supercharger parts, and ignition outlets and braces call for considerable joining with silver brazing alloys.

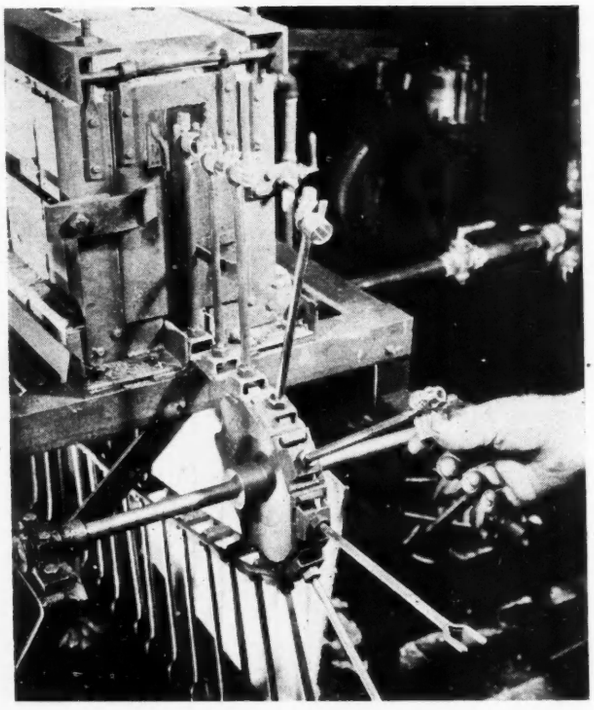
A possible use of silver brazing alloys some time is in the joining of copper fins to cylinder walls. Brazed to the cylinders, the copper fins form an integral unit for increasing heat transfer properties. The high conductivity of the silver brazing alloy and the intimate bonding to the copper fins permit taking the fullest advantage of the heat transfer properties of copper. Much good progress is said to have been made in experiments along this line.

In the making of accessories and instruments as well as in heating devices considerable joining is accomplished by the use of silver brazing alloys.

The use of silver brazing alloys in automobile assemblies had attained volume proportions long before the change-over to the output of war material halted further developments. Beside extensive application in engine and oil float equipment, a good deal of silver solder went into insuring secure joints in frame assemblies, headlight connections, sealed beam headlights and pneumatic systems, temperature controls, oil cleaners and filters, radio equipment and antennae, nameplates and trim.

Consumption of silver by the automotive and aviation industries in forms other than brazing material has been quickened because silver plate offers not only the logical replacement for nickel and chromium in bright work, but also in providing a protective coating for the housings of delicate instruments and for other equipment exposed to atmospheric deterioration.

Extensive scientific research has been and continues to be conducted with a view to overcoming the pro-



Here priming cups and elbows are being mounted on the conveyor for silver alloy brazing in a controlled atmosphere furnace.

Courtesy of Handy & Harmon

(Right) These commercial silver bars were produced as a by-product during the electrolytic refining of copper at the plant of the Calumet & Hecla Consolidated Copper Co. of Michigan.

Courtesy of Handy & Harmon

Courtesy of Handy & Harmon

Silver alloy brazing metal is used for bonding the steel body and bronze tube in making oil floats.

pensity of pure silver to tarnish, and the problem for all practical purposes appears to have been solved. Additions of minute quantities of other metals, especially so of copper, enable silver to conquer its tendency to tarnish and in electroplating the undercoat, usually also copper, practically precludes inconvenience from this "idiosyncracy" of the pure metal.

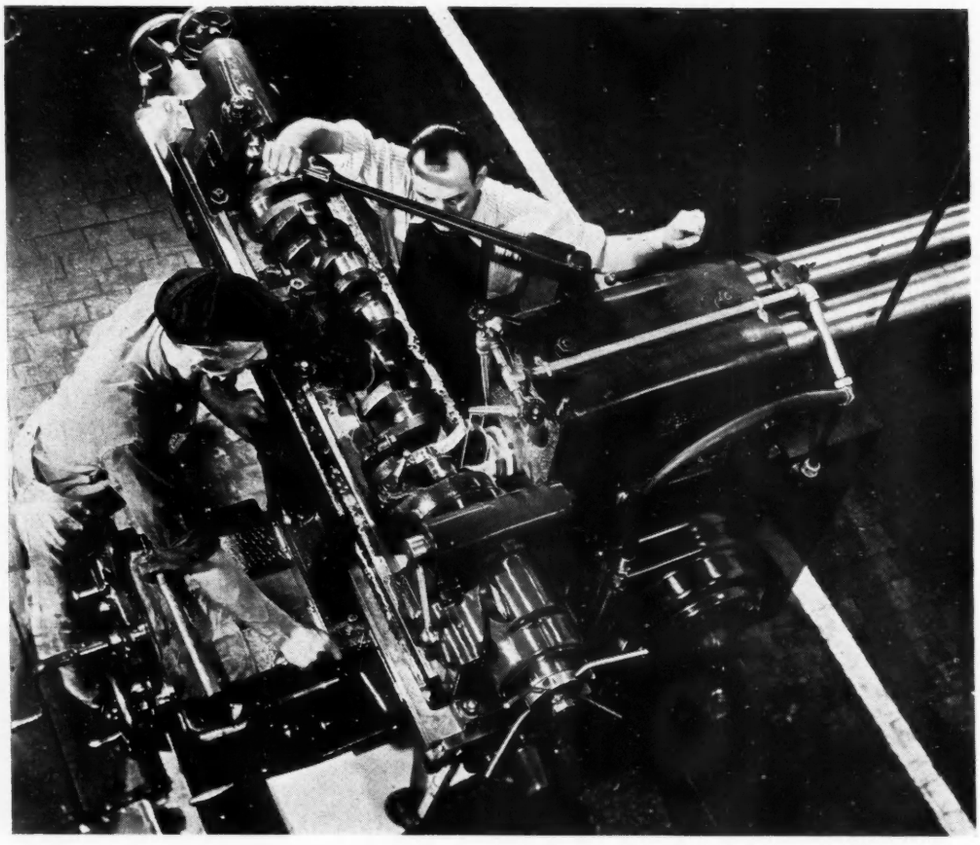
A recent report issued by the American Silver Producers' Research Project, which is being directed by Handy & Harman, New York, states that it appears likely that an important use for silver will result from the application of ultra-light magnesium alloys in the aviation field. Because of the high physical properties attainable in silver-rich magnesium alloys, it seems that some application may eventually be made in alloys of this type. Those sponsoring this research work say that not sufficient progress has been made to permit definite predictions regarding the future in aircraft construction of alloys of silver and magnesium, but that, in so far as their properties have been uncovered, they indicate possibilities, in which users of light alloys will be greatly interested. It is quite possible that silver will play an important role in the further development of alloys yielding the greatest possible strength and lightest weight, a development usually associated with magnesium and aluminum.

The replacing of babbitt by silver in the bearings of engines is a steadily growing practice, it being claimed that silver is capable of carrying a higher load than babbitt, that it is a better heat conductor and that it retains its hardness at temperatures above those feasible with babbitt. Some of these bearings are complete rings, coated inside and outside with silver, while others are split and coated on the inside surface only. According to information received and released by the American Silver Producers' Research Project, these coatings are generally applied by electroplating, although it is possible that other methods of application have been found suitable. Subsequent to application, the silver is machined to hold the close limits on dimensions required in aircraft specifications. This class of silver coatings on bearings consist of the pure metal, the high corrosion resistance of which insures freedom from attack by corrosive agents that may be present in lubricants. Silver linings in this class differ markedly from those made of cadmium, to which a small amount of silver has been added. While silver coatings applied to engine bearings do not differ greatly in thickness from babbitt linings, most silver coatings applied to metals for industrial uses are well under 0.001 in. thick. One of the important considerations in figuring the cost of silver in engine bearings is the ease with which silver that comes off in machining and that which is contained in rejects can be reclaimed.

The use of silver in powder metallurgy is increasing and reflects the growing demand for compounds of silver with such metals as nickel, graphite, tantalum, molybdenum and tungsten, that cannot be alloyed with silver in the usual way. Mixtures of widely varying proportions are made by pressing the thoroughly mixed fine powders and then sintering them at temperatures below the melting point of silver. Some of the resulting products can be rolled into sheet or drawn into rods. Wire suitable for making electrical contacts on automatic heading machines

(*Turn to page* 61, *please*)

How



(Left) Looking down on a Model H Milwaukee Mill in the crankshaft department. This operation is the rough-milling of counterweight sections.

(Below) A view of the compact piston machining line with Sundstrand Stub lathes in the foreground.

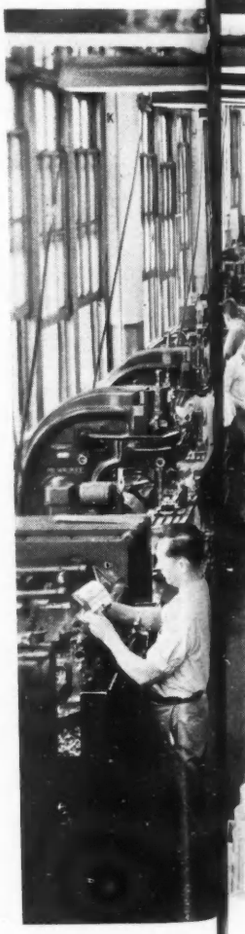
EASILY one of the outstanding accomplishments of the automotive industry is the successful application of mass-production methods in the manufacture of the Rolls-Royce airplane engine by the Packard Motor Car Co. An in-line, V-type liquid-cooled engine, it is subject to uncommonly rigid requirements as to quality of finish and perfection of dimensional tolerances.

As a matter of fact, the application of mass-production methods in the building of this engine demonstrated early in the game that there is but little similarity between an airplane engine and the passenger car engine with which the public is familiar. Some months back we had occasion to comment on the problems involved in the production of the Allison engine and what we said at that time applies aptly to the Rolls-Royce job. When a precision-built mechanism of this nature must be produced in large quantities, it brings to the fore many requirements not encountered in conventional practice.

Consider, first, the manufacture of literally thousands of component parts which have to be finished to extremely close tolerances and subject to many rigid quality controls. Consider, too, that the major elements such as the crankshaft, connecting rods, cylinder block, cylinder head, etc., are relatively long and slender parts. To be finished in accordance with the fine tolerances on all dimensions, such parts have to be handled carefully on machines possessing great rigidity and in massive fixtures which aid in the preservation of accuracy and alignment. Moreover, the great mass of metal that must be removed from the rough forging or rough casting has to be machined in a series of many steps instead of the relatively small number of cuts required ordinarily.

The situation is further complicated by the introduction of special heat treatment procedures and corrosion-treatment of non-ferrous parts. All of these factors combine to make the fabrication of airplane engines a matter of great moment, entirely removed from what have been considered normal machine shop procedures.

Searching analysis of the machine shop picture with respect to any given component, consequently, reveals a greater multiplicity of steps in the process as compared with the building of a conventional engine. Too, the machine tools are of entirely different character. It is true that the Rolls-Royce engine components are machined in turret lathes and multiple-spindle drill presses and crankshaft lathes and grinding machines—designations that are similar to conventional equipment—but it takes only cursory examination to reveal that these machines are not



Packard Builds

Rolls-Royce Aircraft Engines

This is the Seventieth in the series of monthly production features

By Joseph Geschelin

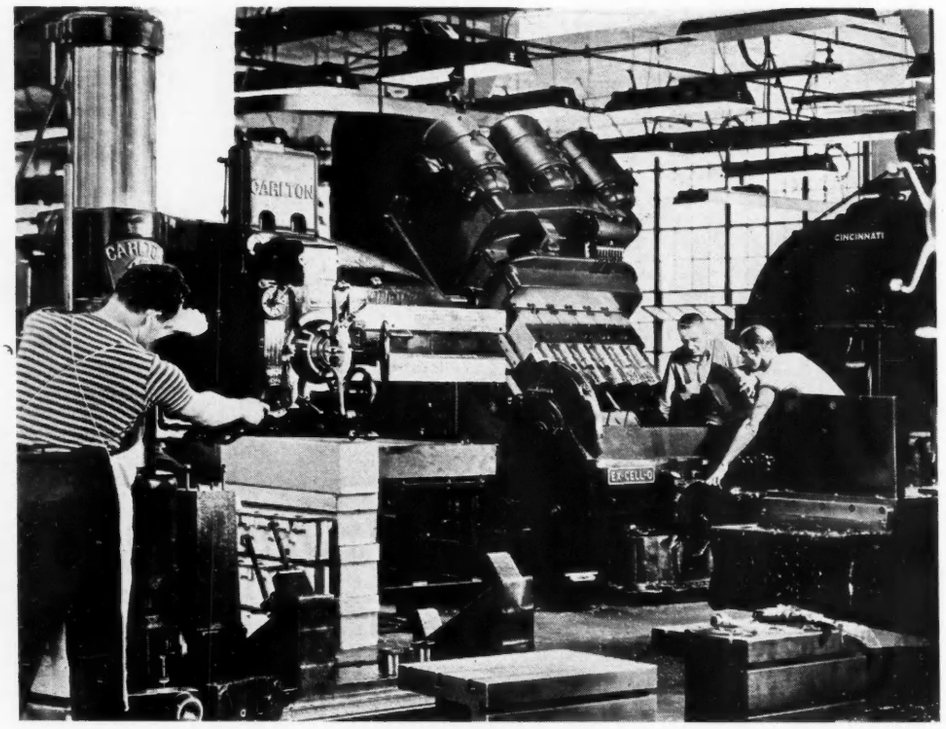
the same ones that we find in a passenger car plant. The fact is that they are much larger, more massive, and endowed with greater motive power. This is a natural corollary of the fact that these machines are required to produce finer finish and finer dimensional accuracy in larger parts.

Another factor that complicates the building of acceptable airplane engines is the final inspection procedure. Each engine, after final assembly, is subjected to a "green" test run for a given number of hours in the test cell. If this is passed successfully, the engine is completely dis-assembled, each piece inspected; then re-assembled and subjected to the final test run in the test cell. If even the smallest component fails to pass inspection, the part must be replaced and the test cell procedure repeated for a "penalty" run. This procedure has been found essential to assure the safety of a valuable fighting ship and its even more precious crew, but it does impose a time factor that limits the productivity of the plant. Compare this with the simple procedure entailed in the manufacture of even the finest passenger car engine.

Faced with the problem of expansion to accommodate increased schedules, Packard offers an excellent example of the conversion process which has been under way in the industry for many months. When the project was first initiated last year, the fine new building additions with this complement of specialized machinery, was considered adequate. Since then the requirements have been steadily increased, making it necessary to provide additional facilities.

At the present time, Packard is operating a "miscellaneous" machine shop department for the fabrication of the many small components of the engine. This department occupies space formerly devoted to passenger car production. The same process is being extended in other directions, expanding into passenger car departments as quickly as the old order can be cleared away. Eventually, the additional facilities will be lined up so as to utilize as much of the available passenger car machine shop equipment as can be readily converted and tooled for the purpose.

Although Packard utilizes the services of a large number of sub-contractors who supply many of the components of the engine, this plant is set up to produce all of the major elements of the Rolls-Royce powerplant and, in this respect, it provides a broader manufacturing picture than do some of the other airplane engine establishments. Some impression of the



A corner of the crankcase section with a Carlton radial drill in the foreground, and one of the six-spindle Ex-Cell-O precision boring machines in the rear. At the extreme right is one of the big Cincinnati Hydro-Tel contour milling machines.

scope of the production program may be gained by noting the major departments and commenting upon the types of equipment found in each one.

Cylinder liners are fabricated in a separate department, starting with long forged tubular bars. The initial operations take place in huge 6 in. 4-spindle cone automatics which turn, bore, and cut-off to length. This department also contains Cincinnati centerless grinders, a battery of Lo-Swing lathes, a battery of heavy duty Potter & Johnston turret lathes, and numerous other machines of various makes.

Connecting rods are finished from the rough forgings in another department. Among the most interesting operations here are found on the Keller profiling machine and the Cincinnati contour milling machines.

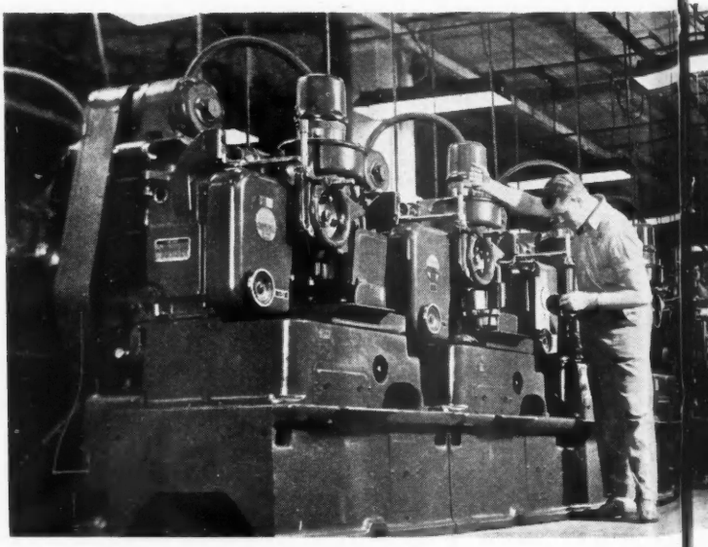
One of the largest units in this plant is the gear department, equipped completely for the machining of gear blanks and shafts, gear cutting, gear grinding, and general finish grinding and precision boring operations. Among the turning equipment in this department are—a large battery of heavy duty chucking type Potter & Johnston turret lathes of single- and two-spindle types; Cleveland Rigidturners; Sundstrand stub lathes; Lo-Swing lathes, Fay automatic lathes. Gear cutting equipment includes the gamut of familiar makes and types employed in accordance with the nature of the gear problem. For example—Gleason generators are used for cutting bevel ring gears and pinions; Fellows gear shapers of high speed type are used for a variety of internal and external gears; Gould & Eberhardt and Cleveland single-spindle hobbing machines for other types of gears; Barber-Colman hobbers of heavy duty type for gear cutting and spline cutting.

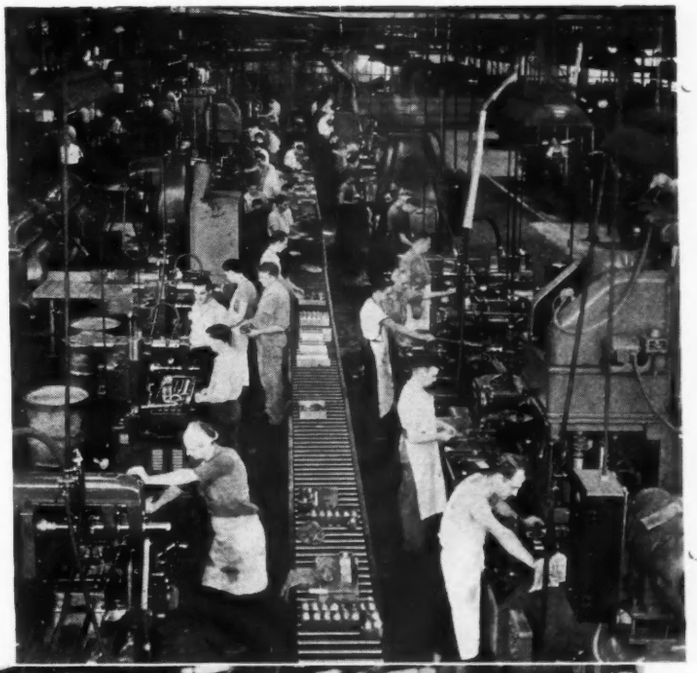
Most of the gears are finished by grinding, using the familiar Pratt & Whitney gear grinders; Gear Grinding Machine Co. grinders; and a large battery of the new Red Ring gear grinders. Finish grinding operations on the gear blanks are handled on Norton, Landis, and Cincinnati cylindrical grinders, while internal grinding is done in Heald grinders of various types.

The crankshaft is machined in a large, compact department containing many specialized machines.

This crankshaft is more closely akin to a large automotive shaft than to the radial engine shaft since it runs about 45 in. in length and is forged with integral balance weights. Apart from the problems involved in the machining of a shaft of this character to exacting dimensional tolerances and over-all surface finish, there is the matter of handling these shafts in the transfer from one operation to another. More in keeping with automotive practice, the entire department is linked by a heavy-duty monorail conveyor system which transports the heavy shafts in special cradles holding four pieces at a time.

The crankshaft department is supplemented with a self-contained polishing room in which the shafts are polished and burred all over while traveling on the familiar type of merry-go-round conveyor.





One of the bays in the connecting rod department — equipped for the machining of bearing blocks for the forked rod assembly.

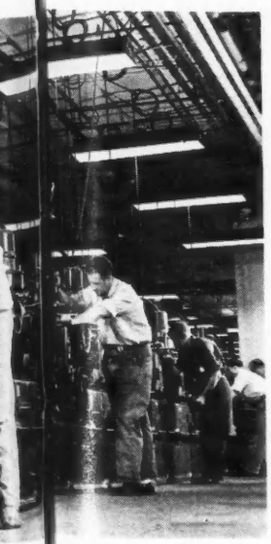
The propeller shaft also is machined completely in this plant and this department, too, is served by a heavy-duty monorail conveyor, carrying four pieces at a time.

Cylinder heads are machined in a self-contained section equipped with a large number of specialized machines of familiar types. Here will be found the huge multiple-spindle Natco and Bausch drilling machines; single spindle and 6-spindle Cincinnati Hydro-Tel milling machines; Ex-Cell-O machines; Cincinnati milling machines; and many others.

In the vicinity of this department is installed a Despatch oven for heating cylinder blocks to facilitate the installation of the cylinder barrels.

Pistons are machined completely in this plant in a specialized line containing familiar makes of equipment including —Sundstrand stub lathes; Natco horizontal drilling units; Heald and Ex-Cell-O precision boring machines, etc.

(Right center) A battery of large Cincinnati Centerless grinders handles the final finish operations on the O. D. of cylinder liners.



(Left) Here is an imposing battery of Fellows High-Speed gear shapers in the gear department.

(Lower right) Typical of the inspection procedure in many departments is the Magnaflux machine in the propeller shaft division.

(Top center) Extreme corner of the large heat treating department, showing a battery of Westinghouse nitriding furnaces for crankshafts. A group of Lindberg furnaces, continuous heat treating furnaces, Gleason quenching machines, and other equipment is arranged in the other sections of this department.

(Left) Close-up of one of the larger Baush multiple-spindle drilling machines on the crankcase line.

Looking down one of the bays of the crankshaft department with cylindrical grinders in the foreground. Here will be found many of the largest sizes of Norton and Landis grinders for turning of pins and journals. Note the heavy duty monorail conveyor for transporting the heavy shafts from one machine to another.

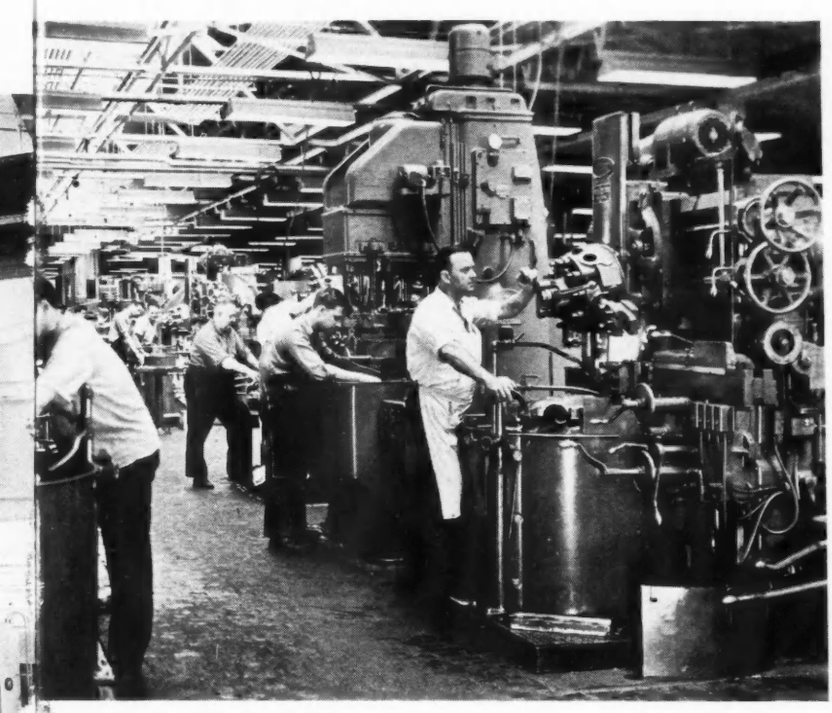
The reduction gear case line features Bullard V-T-L's; six-station W. F. & John Barnes machines with spindles for boring—one machine for rough-boring, another for finish-boring; big Natco and Baush drilling machines; Heald Bore-Matics.

The wheel case is handled in another section, contains a large battery of Bullard V-T-L's; Natco and Bausch drilling machines.

The large crankcase machining section has an imposing array of the huge Natco and Bausch multiple-spindle drilling machines; Cincinnati milling machines; Cincinnati Hydro-Tels of various types; Ex-Cell-O six-spindle boring machines; and a huge W. F. & John Barnes horizontal duplex boring machine handling both ends of the crankcase.

The miscellaneous parts machining department, mentioned earlier, is found in a space formerly occupied by passenger car manufacturing. It contains a wide variety of machining and grinding equipment including —Cincinnati and Kearney Trecker milling machines; Heald Bore-Matics and internal grinders; a number of the abrasive grinding machines; lapping machines and surface grinders; and a large Niagara washing machine fitted with Alfite equipment for fire protection.

Due to the requirements of fine surface finish, free from even minute imperfections, each of the departments such as crankshaft, connecting rod, cylinder liner, gear department, etc., is provided with Magnaflux equipment for inspection.



A section of the supercharger housing machine line. In the foreground and along the line to the rear are some of the many Bullard V-T-L machines found in this plant. At the right is one of the Natco Holesteel multiple-spindle drilling machines.

Electroplating is one of the important technical processes in this plant and is handled in a large self-contained department. Special equipment is provided for the plating of such coatings as tin, cadmium, copper, and indium.

Apart from the self-contained polishing room adjoining the crankshaft department, Packard has one of the largest general polishing rooms to be found in the industry. In addition, special polishing booths are installed in the gear department.

Needless to say, heat treatment is one of the most important activities here when we consider the requirements for the heat treatment of gears and shafts, the treatment of cylinder liners, nitriding of crankshafts, etc. Here are found an outstanding battery of large Westinghouse nitriding furnaces; the latest type Lindberg-Super-Cyclone furnaces capable of great productivity within a limited space; an Ajax salt-bath furnace; Gleason quenching machines for gears; and a variety of other heat-treating and accessory equipment.

In keeping with current practice, cemented-carbide-tipped tools are employed for the milling and boring of non-ferrous parts. This procedure is to be extended to the machining of steel parts as time goes on.

Owing to the relatively large distances that have to be traversed in the linking of raw materials to machine shops, and in transporting finished parts to the assembly department, Packard operates a sizable fleet of industrial trucks of various types supplied by Mercury. These also serve to transport finished engines from assembly to the test cells and to the shipping department.

Excellent seeing for workmen at their machines and for inspectors at their stations is afforded by a comprehensive installation of the modern fluorescent light sources of the type which has been applied so extensively throughout the industry.

The assembly department has many unique features quite different from the set-up in other airplane engine plants. More in keeping with the procedure in a passenger car plant, this department has a series of sub-assembly lines arranged in parallel rows.

The inspected engines when ready for the green run in the test cells, are transported to the tear-down department for inspection and re-assembly. The engine, in various stages of tear-down moves to the end of the department where the large elements such as the crankcase, cylinder blocks, etc., are taken out and washed in the large Detrex degreaser. It may be noted that each of the tear-down lines mentioned above will be provided with its own Detrex degreaser of suitable size.

Moving to the other side of the tear-down department, the re-assembly of the engine begins with the installation of the crankcase, as in the final assembly procedure, then picks up the sub-assemblies from the far end of the individual tear-down lines.

An excellent perspective of many of the individual machine shop processes can be gained from the comprehensive pictorial section in which each of the subjects is thoroughly captioned.

Tin Alloys for British Bearing Metals

As a result of the urgent need for the utmost economy in the use of tin, owing to recent events in the Far East, a technical committee appointed by the British manufacturers of plain bearings and bearing metals has made recommendations which have been accepted by the Ministry of Supply and which, it is believed, will ultimately lead to a saving of 65 per cent of the normal consumption of tin in plain bearings.

To achieve this end, the useful white metal alloys have been divided into four groups, according to their tin content, and the manufacturers' committee has prepared a list of the major applications of bearing metals, showing the alloy group they believe to be applicable and adequate in each case. It is realized that there will probably be special cases and exceptions to the general classification. These, it is suggested, should be met by appeal to a technical adviser appointed by the Ministry of Supply.

The committee recognizes that a certain amount of risk will be entailed, but has been guided, it states, by

(*Turn to page* 80, *please*)

By Brig. Gen. G. M. Barnes*

EVERY day of battle in the current world war adds emphasis to the fundamental importance of tanks in modern warfare. The two prima donna weapons of the present European war have been the airplane and the tank; however, neither of these weapons has proved to be completely effective without the assistance of the other. The Germans in Poland, France, and elsewhere have won quick and decisive battles when these two weapons have been used in mutual support of each other. On the other hand, where the airplane has been forced to act alone, as in the Battle for England, the results have not been decisive.

Under the Blitzkrieg method of employing airplanes and tanks, the former are first used to soften the enemy; then tanks follow up the advantage with mass attacks concentrated for a break-through. Being highly mobile, the tanks can attack the weakest part of a long defensive line. It is very difficult for an army on the defensive to stop a massed attack of tanks with anti-tank guns spread out to defend a long line. Pill boxes and other defensive strong points with anti-tank guns capable of penetrating a tank's armor usually are carefully avoided by tanks in such an attack. It is probably true that the best defense against a determined tank attack is an equally determined offensive with an equivalent or larger number of opposing tanks.

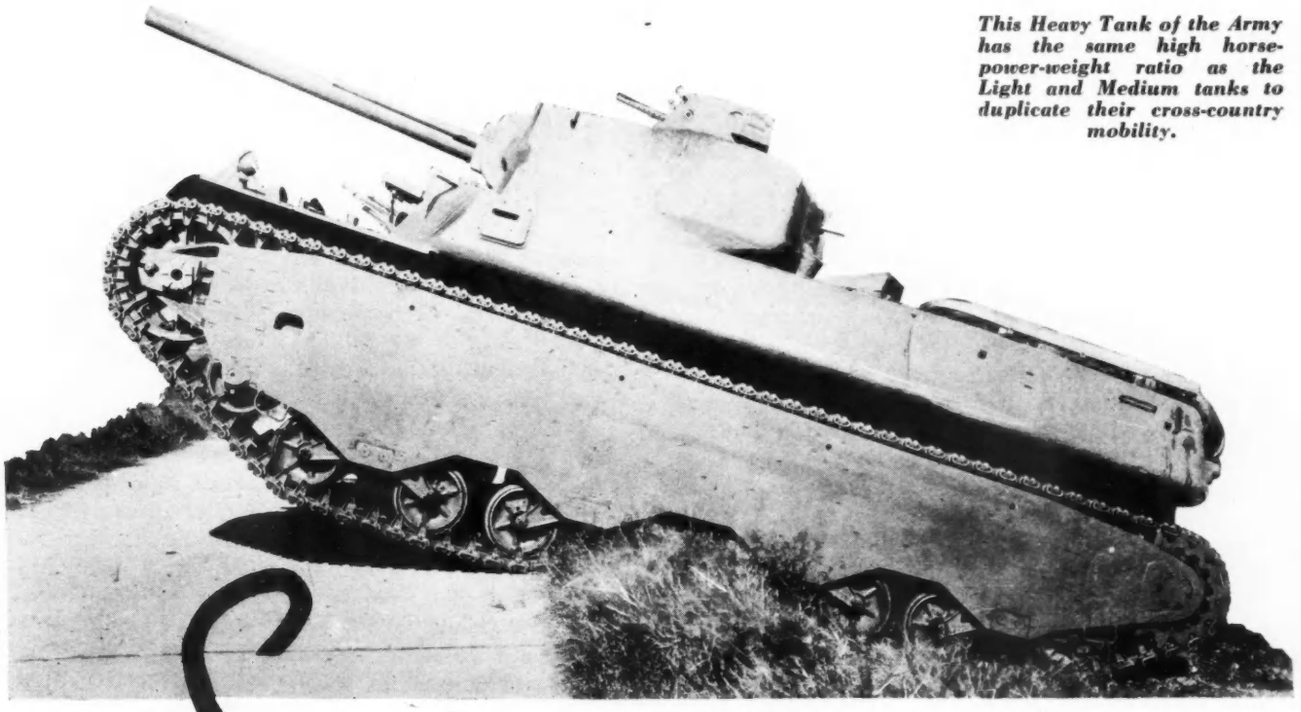
The layman, in endeavoring to make a comparison between foreign and American tanks, is often confused by the rather loose classification of tanks into light, medium, and heavy types. Under the classification of light tanks, European countries often include vehicles weighing from five to six tons as compared with the American standard light tank of 14 tons which would be classified as a medium tank in some foreign countries. It is also well to remember that a large percentage of foreign tanks are now of obsolescent models while the tanks with which our armies are now being equipped are of the very latest patterns.

The design of a tank, like that of any other piece of machinery, is a question of making satisfactory compromises between the various conflicting characteristics of the vehicle and is necessarily based upon military requirements. The military characteristics which must be considered are: armament, armor protection, mobility (including trench-crossing ability, maneuverability, speed, and radius of action), weight, number of men in crew, and speed of production. All these basic characteristics, of course, are interdependent, one upon the other.

The problem of the military tank designer is to balance these conflicting characteristics. As the designer

*Assistant Chief, Industrial Service, Engineering, Office of the Chief of Ordnance, Brigadier General, U. S. Army. This article is republished from Army Ordnance.

Equipment on the Army's new Heavy Tank includes armament of exceptionally high fire power.



This Heavy Tank of the Army has the same high horsepower-weight ratio as the Light and Medium tanks to duplicate their cross-country mobility.

Supertanks

Developments leading to this new heavy weapon

does not know the tactical situation under which the tank is to be employed, he strives to make a type of vehicle which will most nearly fit the probable situations which may be encountered in warfare.

The purpose of any tank is to carry safely the guns, ammunition, and personnel necessary for their operation to the desired point in the minimum of time in order that these weapons may be brought to bear effectively and decisively upon the enemy. Tanks must have armament capable of performing the following general missions: (1) The penetration of armor plate, which is best accomplished by high-velocity, low-trajectory weapons involving the use of high-quality armor-piercing ammunition; (2) High-explosive demolition, which is most effectively accomplished by a low-velocity thin-walled projectile; (3) operation against personnel targets, which are most effectively overcome by small-caliber machine-gun fire; (4) anti-aircraft fire, which involves precision firing against the high-speed airplane moving in three dimensions through space.

The desire of the tank designer to equip his tank with a large number of high-power weapons is quickly restricted by the number of men in the crew, the space available for guns and ammunition, and by the limitations of weight. To provide space to serve effectively the several types of weapons required may result in a vehicle which has a large silhouette and which is too heavy if the desired armor protection is maintained.

While this subject of armament is confidential as to detail, I am very happy to report that during the last year such rapid progress has been made toward solution of these problems that improvements in the accuracy of fire of our tank weapons of over 1000 per cent has been possible.

The armor carried by the tank makes it possible for the vehicle to live on the battlefield. Naturally, the designer would like to equip his tank with armor of such thickness that it would be impossible for any type of projectile to penetrate it. It is always a great disappointment to the layman to learn that the armor of any tank can be penetrated and perhaps this was one of the factors which held back the universal acceptance of tanks for many years. It was always easy to reason that the tank was a very vulnerable vehicle and that its armor could be penetrated readily.

In these arguments against the tank as a fighting vehicle, the principle of employment en masse was too often overlooked. Armor provides protection and cover for the working mechanisms and personnel. It is of interest to note that, according to World War records, 60 per cent of battle casualties resulted from low-velocity fragments thrown from projectiles. It is,

(*Turn to page* 62, *please*)

First Official Report on

COMPANIES in the automotive industry, operating 600 plants, turned out $266 million worth of war materials during February, according to the first of a series of monthly reports released by Ernest C. Kanzler, chief of the Automotive Branch of the War Production Board. This is at an annual rate of more than $3 billion compared to a total of $3,630,000,000 worth of passenger cars and trucks sold at wholesale by the industry in 1941. The war production figures are based on the reports of seven automobile manufacturers, 25 truck makers and 148 parts manufacturers.

The automotive industry—that part of it covered by the report—is now committed to produce war goods at an annual peak rate of $14 billion, so the February report indicates that this part of the industry has reached a rate 22½ per cent of its goal. But as complete conversion of the industry was just getting started in February, with passenger car production halting Feb. 10, it would not be surprising if the monthly production total reached $800 million by July, which is more than double the February rate.

By E. L. Warner, Jr.

"This rate will be greatly accelerated as the difficult and intricate jobs of retooling are being completed and the products really start coming off the production lines," states Mr. Kanzler. "Many of the largest projects, while under way, are still in the pilot stages. After the first war material comes off these lines and satisfies inspection, it still takes some little time to get quantity to flow through these lines in production."

During all of 1941 the automotive industry, says the report, produced war materials valued at approximately $1 billion, so the February production total is equal to 27 per cent of the previous year's output. Of course a flood of new orders were placed with the industry after Pearl Harbor which were not reflected in 1941 production.

Production in these automotive plants totaled 39½ million man-hours of labor during February, which is 46 per cent of the peak 1941 production month and 30 per cent of what it will reach at the maximum war load peak. Employment in the 180 companies reporting totaled 340,959 workers in February, which is 45 per cent of the 1941 peak of 759,610 employes and 37 per cent of the anticipated war peak of 929,000 workers.

Statisticians from the Division of Research and Statistics of the War Production Board, headed by Dr. Stacy May, employ the "value added" figure as a truer criterion of the work done in automotive plants. Costs of raw materials and parts supplied by subcontractors are deducted from total sales to obtain a more accurate picture of the work actually done in the plants. On this basis, the "war load" of the 180 automotive companies reporting is figured at a "value added" rate of $7 billion annually and February "value added" output was $136 million, or 39 per cent of the 1941 peak rate.

Rapidity with which the conversion program is moving was indicated by K. T. Keller, president of Chrysler Corp., who revealed that out of seven major war contracts undertaken by Chrysler prior to Pearl Harbor, six are already in volume production and shipments on the seventh will begin in about 30 days. Chrysler is producing or preparing to produce 24 items of war. Every one of Chrysler's 19 automobile manufacturing plants in the U. S. are being utilized as much as possible on war work. Having beaten its original tank production schedule by seven months, Chrysler is preparing to change over from the M-3 to the bigger M-4 tank in record time. Production of cannon is rapidly increasing and the big April schedule was shipped in the month's first 20 days. May's shipments will be double what was regarded two months ago as a big task.

General Motors Corp., the largest single producer in the automotive industry with nearly $6 billion in war orders, has undertaken to produce more than 10 per cent of the nation's requirements for war material fabricated from metal. GM has more than 1000 orders and contracts for war materials. Of 93 GM plants, 71 are engaged in war work, 14 are being retooled for war work, five are awaiting completion of contract negotiations, and three have been leased to other producers. Eight new plants are in the process of construction and negotiation, including a new aluminum forge plant to be operated by Chevrolet, which will be one of the largest plants of its kind in the world.

Seventy-seven per cent of General Motors' machine tools are at work or being retooled or rebuilt for war production. This totals 54,873 machines, while 16,950 machines not adapted to GM war work are available to other war material contractors. Employment on war orders totaled 170,598 workers in mid-April, of which 8 per cent were skilled tool and die workers and 21 per cent were engineers, supervisors, factory clerks and accountants.

General Motors' deliveries of war materials in the first quarter of 1942 totaled $261,084,959, which translates into an annual rate of more than $1 billion. The first quarter war shipments were 65 per cent greater than in the fourth quarter of 1941 and more than four times the volume of the first quarter of 1941.

GM is committed to produce three separate types of complete airplanes, including a four-engine bomber

Conversion Accomplishments

Even in February with Plants Largely Disrupted by Conversion, Production of War Products Was Over $3-Billion Annual Rate. Figures for 180 Companies Indicate Current Production Value Greater Than Peacetime Output with Rate Rapidly Increasing as Conversion Progresses.

and a U. S. Navy fighter plane. L. R. Grumman, president of Grumman Aircraft Engineering Corp., recently revealed in his company's annual report that Eastern Aircraft Division of GM will manufacture certain Grumman models for the Navy. Arrangements have been made under which Grumman will supply design data, drawings, engineering and other services to permit GM to build the airplanes in five eastern plants of the corporation.

The automotive industry is taking an increasingly larger part in the nation's aircraft production program and will be a major factor in building up the huge air armada necessary to win over the Axis power. One of the earliest automotive companies to enter the airplane procurement program was the Murray Corp. of America, which contracted to make airframe subassemblies for Douglas attack bombers in February, 1941. Murray is now hitting maximum production on this job 11 weeks ahead of the forecast dates. Formerly producing body panels and other parts for Ford, Murray had only 100 persons previously familiar with the aircraft industry when it began negotiating for the Douglas contract. A party of Murray engineers visited the West Coast to familiarize themselves with production technique at the Douglas plant.

Airframe production was found to present different problems than body building. Automobile body panels required 100 to 200 stampings and 50 to 400 standard parts, such as nuts, bolts and rivets. A pair of bomber wings require 5400 parts, with an additional 1500 standard parts, including 500 types and sizes of rivets. A total of 55,000 rivets go into the manufacture of these wing sets. Tooling requirements for the Douglas order called for 1393 dies, 1838 jigs and fixtures, 1688 templates and patterns and 108 routers and gages. A total of 725,000 man-hours were required to build these tools exclusive of those purchased outside. The original Douglas tooling program was completed in December, 1941.

The Douglas tooling requirements were 28 times that for Ford automotive work, which required 109 dies and 74 jigs and fixtures on one typical body job. In automotive body production, there was approximately one inspector to each 100 production workers. Now the ratio on airframe manufacturing is one inspector for every nine workers. Murray also is engaged in the manufacture of engine nacelles and outer wings for Boeing Flying Fortresses and is expected to begin tooling soon for subassemblies for a fighter plane.

Murray engineers redesigned a searchlight for the Army by the substitution of steel stampings for aluminum forgings that will save 700 lb. of aluminum per searchlight. The steel stampings have been engineered so they are interchangeable with the aluminum castings for replacement purposes. Murray will use a former automotive body top press for the steel stampings.

Murray also is cooperating with Ford, its former body customer, in providing heat treating facilities for special steel sheets needed for war work. In order to maintain the steel sheets at a constant temperature, Ford built a fleet of refrigerated trucks which pick up the steel sheets at the Murray ovens and haul them back to the Ford plant for further processing.

Reporting on the machine tool listing service of the Auto-

(*Turn to page* 57)

Comparison of Wartime and Peacetime Production of the 180 Companies in the Automotive Industry

AUTOMOBILE MANUFACTURERS (7)

	Value of Output (Annual Rate)	Value Added (Annual Rate)	Workers	Production Hours (Annual Rate)
1941 peak month	$ 6.7 billion	$2.7 billion	487,559	620 million
Maximum war load	10.0 billion	5.0 billion	619,246	1020 million
February 1942	1.5 billion	0.7 billion	170,694	216 million

TRUCK MANUFACTURERS (25)

	Value of Output (Annual Rate)	Value Added (Annual Rate)	Workers	Production Hours (Annual Rate)
1941 peak month	$ 0.7 billion	$0.2 billion	31,016	40 million
Maximum war load	1.0 billion	0.2 billion	28,579	50 million
February 1942	9.3 billion	0.1 billion	13,600	20 million

PARTS MANUFACTURERS (148)

	Value of Output (Annual Rate)	Value Added (Annual Rate)	Workers	Production Hours (Annual Rate)
1941 peak month	$ 2.1 billion	$1.2 billion	241,035	360 million
Maximum war load	3.0 billion	1.9 billion	281,669	520 million
February 1942	1.3 billion	0.8 billion	156,665	240 million

TOTALS FOR 180 COMPANIES

	Value of Output (Annual Rate)	Value Added (Annual Rate)	Workers	Production Hours (Annual Rate)
1941 peak month	$ 9.6 billion	$4.2 billion	759,610	1025 million
Maximum war load	14.1 billion	7.1 billion	929,494	1595 million
February 1942	3.2 billion	1.6 billion	340,959	475 million

Weight Transfer Between Axles Due to Braking

Type	Four-wheeler	Six-wheeler	Tractor-Semi-Tr.
Body length	15 ft	20 ft	20 ft
CA dimension	120 in	138 in	
Fifth wheel offset			6 in
Wheelbase	194 in	188–48 in	140–182½ in
Static tare weight	13,500 lb	18,400 lb	19,000 lb
Front	6,300 lb	6,200 lb	5,650 lb
Middle		6,100 lb	7,350 lb
Rear	7,200 lb	6,100 lb	6,000 lb
Static payload	11,500 lb	21,600 lb	21,000 lb
Front	1,600 lb	1,600 lb	400 lb
Rear		10,000 lb	9,100 lb
Middle	9,900 lb	10,000 lb	9,500 lb
Static gross weight	25,000 lb	40,000 lb	40,000 lb
Front	7,900 lb	7,800 lb	6,050 lb
Rear		16,100 lb	16,450 lb
Middle	17,100 lb	16,100 lb	17,500 lb
Height center of G. (above spindles)			
Truck or trailer	39 in	39 in	49 in
Tractor			11 in
Decelerating rate	14.35 ft/sec²	14.35 ft/sec²	14.35 ft/sec²
Inertia transfer:			
Front	+2,250 lb	+3,250 lb	+ 490 lb
Middle		−1,625 lb	+3,010 lb
Rear	−2,250 lb	−1,625 lb	−3,500 lb
Brake torque transfer:			
Front	+1,150 lb	+ 330 lb	+1,460 lb
Middle		− 165 lb	− 630 lb
Rear	−1,150 lb	− 165 lb	− 830 lb
Total transfer:			
Front	+3,400 lb	+3,580 lb	+1,950 lb
Middle		−1,790 lb	+2,380 lb
Rear	−3,400 lb	−1,790 lb	−4,330 lb
Dynamic distribution	25,000 lb	40,000 lb	40,000 lb
Front	11,300 lb	11,380 lb	8,000 lb
Middle		14,310 lb	18,830 lb
Rear	13,700 lb	14,310 lb	13,170 lb
Per cent on front:			
Static	31.6	19.5	15.1
Dynamic	45.2	28.4	20.0

Problems Presented in

SIX-WHEELERS offer no greater problem in the attainment of maximum safe and controllable braking than do other types of heavy vehicles. Analysis of the dynamics of braking indicates that the six-wheeler can be made to give better braking performance than any.

Specifically, the complaints concerning the behavior of six-wheel brakes involve what is known as bogie hopping and loss of steering control when brakes are applied on slippery roads. On the credit side of the ledger, six-wheelers are generally credited with being less liable to skidding than either four-wheeled straight trucks or tractor-semi-trailers. In respect to general stopping ability, also, six-wheelers rate high.

The first of the defects complained of, bogie hopping, is peculiar to rigid six-wheeled vehicles and multi-axle trailers. The steering difficulty, however, is found in both rigid and articulated types of multi-axle vehicles, that is, in both six-wheel straight trucks and in tractor-semi-trailers. Nevertheless, it is said to assume its severest form in the rigid six-wheeled truck.

Braking Fundamentals

It is well to recognize that short of failure to stop within a reasonable distance, practically all irregularities of braking arise from improper distribution of braking force among the wheels and in all such cases the evils arise from the untimely locking of one or more wheels. Such irregularities cannot be disposed of by merely cutting out or reducing to impotence the offending brakes, for this will reduce the total retardation in a corresponding degree.

Retardation by means of friction brakes acting upon the wheels of road vehicles is limited by two principal factors, namely the coefficient of adhesion between the tires and the road and the degree to which the distribution of braking force between the wheels coincides with the imposed load on each wheel. The first factor is usually disposed of by assuming for pneumatic tires on average improved roads a coefficient of 0.6. The second is much more complicated and difficult to ascertain.

Adhesion Coefficient

Of course, the assumed constant of 0.6 is in reality not a constant at all. The adhesion of the tires constantly changes. Not only does it differ as between different types of paving, but at different points along any given roadway, while rain, snow, sleet, mud and ice produce tremendous changes. Tires differ and as the treads wear away they change. However, over the distance required to make a normal stop, the changes in adhesion may be assumed to affect all of the tires on a vehicle approximately alike and so will not materially upset the dynamics of braking.

The limitation imposed by the 0.6 coefficient is by no means an embarrassment, for it permits a rate of retardation of 19.32 ft. per sec. per sec., which if sustained uniformly is equivalent to a braking distance of 22.2 ft. to stop from 20 m.p.h. However, since perfect brake distribution is by any means now known unattainable, this rate of deceleration likewise is unattainable on prevailing roads.

In perfect braking each brake would exert a retarding force just below that at which the shoe would seize the drum and cause the wheel to slide. Any lesser

*By W. F. Benning and M. C. Horine**

the Designing of Six-Wheel Trailers

force would reduce the rate of retardation. Any greater force would cause all wheels to slide simultaneously, thus reducing the rate of retardation again and endangering the directional stability of the vehicle as well.

Braking Distribution

Any deviation from this perfect balance of braking force against imposed load on each wheel will cause one or more wheels to lose traction and slide before the others do. If the sliding wheels are the steering wheels, then control of steering will be jeopardized. If the sliding wheels are on one side, the vehicle will have a strong tendency to skid. In fact every vagary of imperfect braking can be traced back to imperfect coincidence of braking force and imposed load.

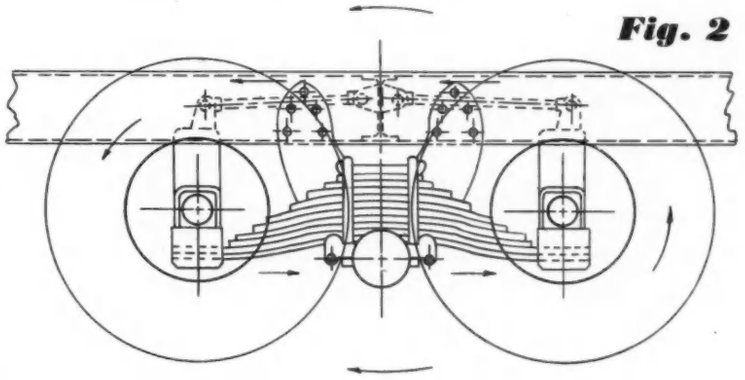
If only static weight distribution could be maintained with the vehicle in motion, the attainment of perfect braking balance would be conceivable, or even if the transfer of weight from axle to axle were always the same under maximum brake application, a far closer approach than is now in sight could be reached.

Static and Dynamic Weight Shifting

Not considering transverse shifting of weight, due to road crown, unequal distribution of the freight in the body, sidesway and centrifugal force in rounding curves, the transfer of weight longitudinally results in a constant shifting of weight from axle to axle. The influences effecting this shifting are both static and dynamic. Under the static classification are differences in the weights of payloads, unequal longitudinal distribution of the freight, differences in the density of freight and road gradient. Under the dynamic classification are the inertia of the vehicle and its load under acceleration and deceleration and the fluidity of the load itself, the jouncing of the springs and tires and the torque reactions of driving and braking.

Maximum braking effectiveness requires that each wheel shall exert a retarding force exactly equal to 0.6 times the actual weight imposed upon it. If this imposed weight were constant on each wheel, this would be a simple matter of adjusting brake chamber sizes, line pressures, cam contours or lever lengths to produce perfect balance; but even if the static weight distribution was constant, the dynamic forces would unset such uniformity. The dynamic effects, however, could be neutralized if the center of gravity could be located in the same plane as the wheel spindles and if axle torque were balanced out.

Fig. 2



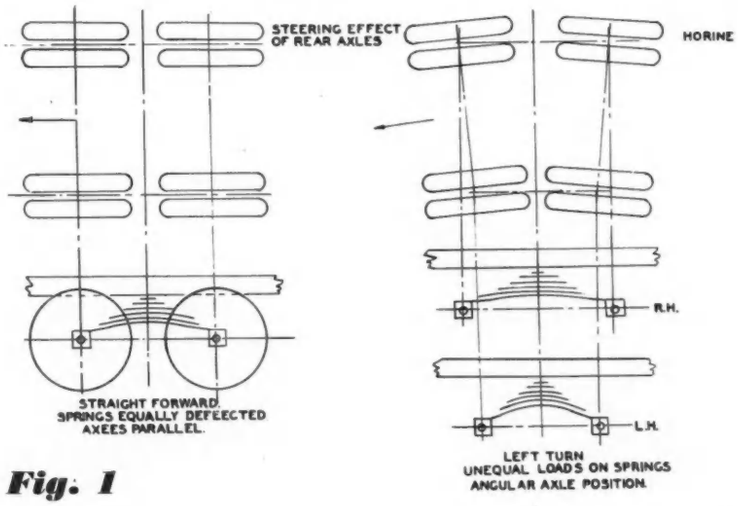

STEERING EFFECT OF REAR AXLES
HORINE
STRAIGHT FORWARD SPRINGS EQUALLY DEFEECTED AXEES PARALLEL
R.H.
L.H.
LEFT TURN UNEQUAL LOADS ON SPRINGS ANGULAR AXLE POSITION

Fig. 1

A fact not generally realized is that while grades cause a gain in weight on the axles on the low side and a loss of weight on those on the high side, this gain and loss do not correspond, so far as pressure of the tires on the road surface is concerned. In other words, the total ground pressure decreases with the grade.

(*Turn to page 70, please*)

* This article was presented by W. F. Benning and M. C. Horine of the Mack Manufacturing Corp. before the recent annual meeting of the SAE.

Tanks of Other Lands

Ansaldo tanks of Italian manufacture like the one shown here are used in Brazil's mechanized forces. Major Deo Costa, commander of the mechanized section, is riding in it

Press Association Photo

Anti-tank fire stopped this Japanese tank in Malaya. In addition to guns at the front in the hull, there are two guns in the turret, one at the front and the other at the far side.

Press Association Photo

Sweden prepares for the worst. Mechanized equipment of her army includes heavy armored combat tanks of this type.

Wide World Photo

Making.....

Welding Electrodes

.....*Go Farther*

WITH WAR production making a big demand on welding materials and their conservation becoming increasingly important, Clayton B. Herrick, welding engineer of the Lincoln Electric Co., urges that particular attention be given in the factories to utilizing them, particularly electrodes, to maximum advantage. Analyzing this problem, he stresses a number of factors affecting the efficient use of electrodes that if controlled, will result in a faster rate of production and also at the same time full utilization of welding materials to prevent their waste.

An important factor is the selection of the right type of joint as a serious waste of weld metal results by using a complicated joint where the more simple type of connection will suffice. Fit-up should be given most careful consideration as it affects not only the cost of the welded joint as such, but also the performance of the finished product. As an illustration of the effect upon cost in a very simple fit-up, consider the case of a T-weld with ¼-in. plates. Assume that the cost of deposited metal is $1 per lb. Then if the joint is properly fitted up, the cost per foot of joint (two beads), would be $.40. If, however, there is a gap between the vertical plate and the horizontal plate of 1/16-in. the cost is increased to $.58 per ft. If this discrepancy is ⅛-in., the cost is increased to $.80 per ft., resulting in a difference of $.18 to $.40 for 1/16-in. and ⅛-in. gaps, respectively.

EFFECT OF CHANGING ELECTRODE SIZE

Electrode Size	1/8	5/32	3/16	1/4	5/16	3/8
Amperes	110	130	150	250	325	425
Arc Volts	24	25	26	30	34	38
K.W. at Arc	2.64	3.25	3.9	7.5	11.1	16.1
Consumption Rate, Lbs. per Hr.	2.6	3.3	3.95	7.5	10.7	16.2
Deposit, Lbs. per Hr. (50% Operating Factor	0.87	1.1	1.32	2.5	3.57	5.4
Efficiency of Set (%)	47	50	51	55	59	59
Kilowatt Input	5.6	6.5	7.65	13.65	18.8	27.3
Interruptions per Lb. Consumed	18	12	8	5	3	2

ITEMIZED COST PER POUND DEPOSITED METAL

Labor	$1.150	$0.909	$0.758	$0.400	$0.280	$0.185
Overhead	1.150	.909	.758	.400	.280	.185
Power	.064	.059	.058	.055	.053	.051
Electrode	.150	.135	.127	.127	.127	.127
Cost of Interruption (Including Overhead)	.050	.033	.022	.014	.008	.005
	$2.564	$2.045	$1.723	$0.996	$0.748	$0.553

From the standpoint of conservation, the largest diameter electrode that can be used effectively is the best. For example, the saving goes up to 40 per cent for a ¼-in. electrode as compared to the 3/16-in. size. In the accompanying chart and tables is shown the effect of electrode size on economy, how the cost of welding goes down as the electrode size goes up. In the larger sizes, long electrodes will result in a reduction in the number of stub ends and in a time saving by eliminating interruptions to change rods.

The proper voltage and current settings are important as every electrode is designed to operate at a certain voltage and within a specified current range. When the current is too high or too low, there will be excessive splatter loss or inferior welds. Emphasis should be placed on following the manufacturer's recommended procedure. And with modern high capacity welding generators, efficiency will be much greater. It is estimated that a modern 40-volt generator will produce 7.7 in. of joint per electrode as against 6.6 in. for an older machine.

In selecting the correct type of electrode, it should be recognized that although the general purpose electrode will produce satisfactory welds under virtually every condition, special electrodes such as the heavily coated fast flowing types will prove more efficient. The electrode should have and maintain a uniform coating, since it is the coating that produces the protecting shield and also controls the fluidity of the metal, penetration, shape of the beads, physical properties and composition of the deposit.

To provide the quality of weld that will meet the necessary physical properties is a basic requirement. But in addition, the electrode that keeps slag and splatter to a minimum and produces flat beads is also desirable to eliminate waste of material. Bending it should be avoided as this habit results in a waste of from 25 to 33 per cent of the electrode. Material also will be saved by avoiding an excessive number of beads and by using the electrode down to the minimum stub end. In one shop where the stub ends varied greatly in length, the waste was 17½ per cent in electrodes, a loss of $268. At the rate electrodes are being used today in war production, saving of the stub ends becomes an important item.

Steel and Wood Design

completed for North American Combat Training Planes

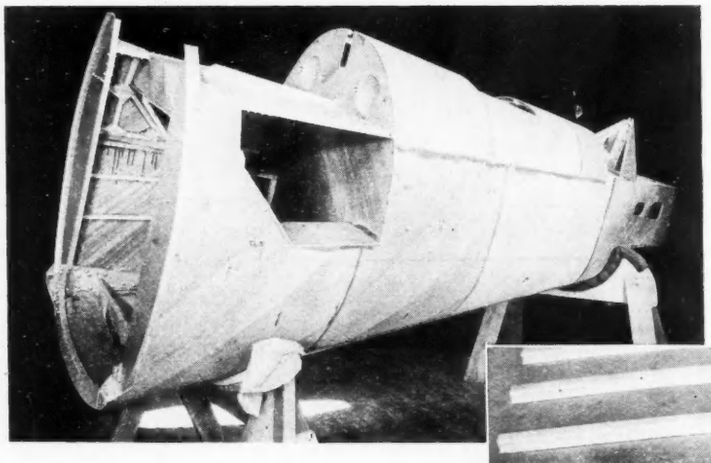
SUCCESSFUL application of a low carbon, low alloy steel to save aluminum in the construction of AT-6 single engine combat training planes for the Army and Navy is an accomplishment of North American Aviation engineers. At the time that the use of this type of steel was pronounced satisfactory, plywood structures already were going into these advanced trainers on the assembly line at the company's Dallas, Tex., plant. Research work along this line was started more than a year ago and the new construction is said to provide equally or possibly superior strength and safety factors.

On AT-6 trainers the combination of steel and plywood will eliminate 75 per cent, by weight, of aluminum alloy. At the same time, North American engineers are considering the possibility of applying the new materials to combat types—the B-25 bomber and the Mustang fighter. For each 4000-lb. AT-6 advanced trainer built, 1246 lb. of vital aluminum alloy will be saved for other war production. One thousand such trainers will save 623 tons or enough aluminum to build 420 pursuit planes or 150 medium bombers. Another interesting result of this latest development in aircraft production is that wood parts will be produced by furniture and wood products firms, thus automatically expanding aircraft production capacity by utilizing otherwise idle equipment and factories.

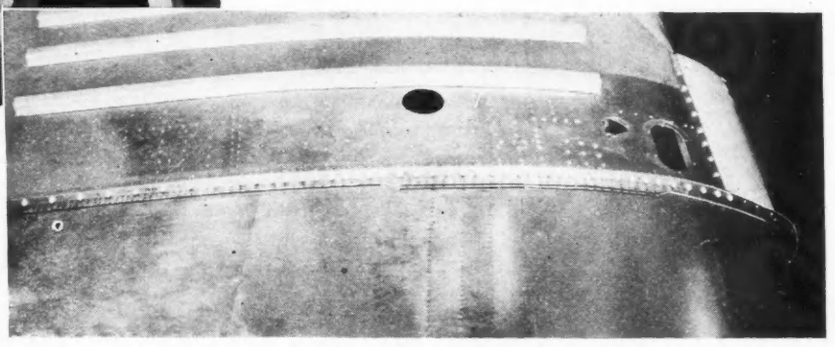
Except for a smoother surface on wings and fuselage, the new planes will look much the same as their aluminum predecessors. The exterior surface of steel wings will be smoother because rivet heads will be eliminated, and the sections joined by spot welding process. The wood assemblies will be joined by glue.

Spot welding's importance is apparent. Some 35,000 rivets go into a typical pursuit plane, 150,000 into the average bomber, and a single AT-6 trainer uses 52,336 rivets of various sizes and shapes. Most riveting, a two-man operation, costs in the neighborhood of 5 cents per rivet, according to some estimates, including drilling, cleaning, insertion of rivet, driving the rivet, inspecting, and the occasional waste of entire assemblies because of faulty rivets. Spot welding, on the other hand, can be done by one operator at a rate of 350 to 1000 spots per min. and at an estimated net cost of 1/10 of a cent per spot.

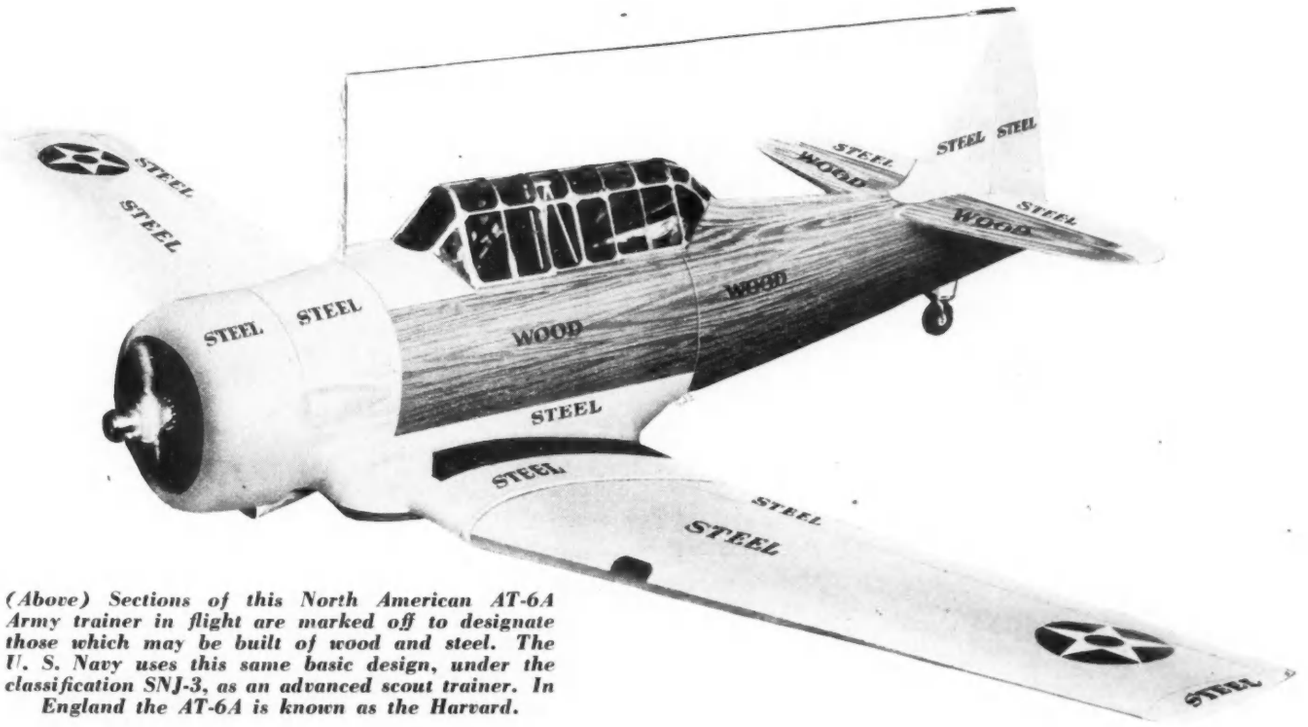
The only disadvantage encountered with the new materials is a slight increase in the ratio of weight to strength, but metallurgical research and structural improvements promise to give the steel planes a weight parity with aluminum alloy planes before the end of



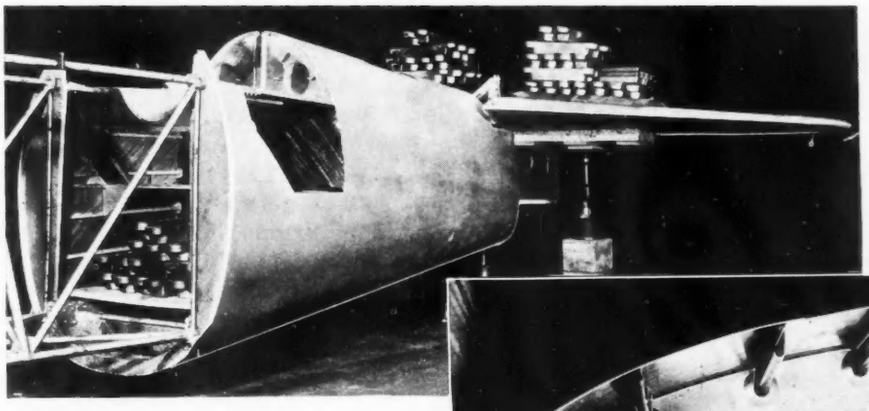
(Below) An unusual illustration of the contrast between previous construction methods and the latest type developed by North American engineer. In the upper section of this photograph is a wing center section built of aluminum alloy which is secured by rivets. In the lower portion of the picture is the outer panel built of low carbon low alloy steel, and held together by spot welding. The attaching bolt angle (photo center) also is extremely illustrative. The attaching bolt nearest camera is made of steel, while the angle opposite is aluminum alloy.



(Above) Wood semi-monocoque rear fuselage section during assembly for a AT-6A trainer. It is constructed principally of plywood.

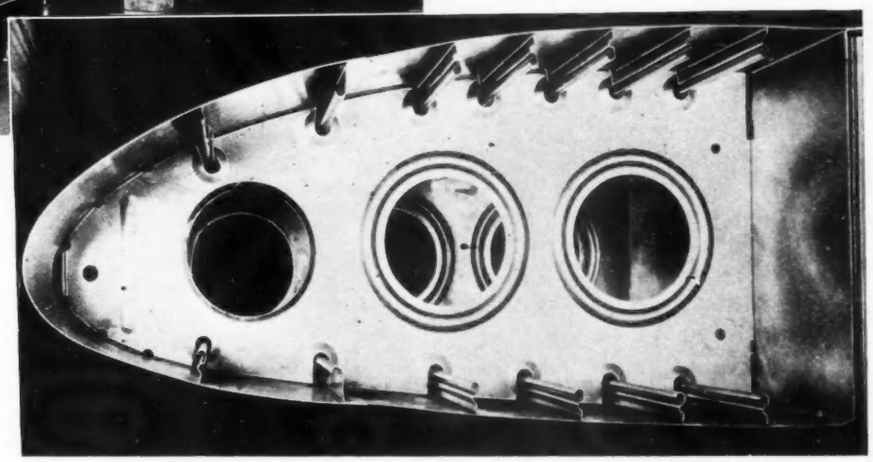


(Above) Sections of this North American AT-6A Army trainer in flight are marked off to designate those which may be built of wood and steel. The U. S. Navy uses this same basic design, under the classification SNJ-3, as an advanced scout trainer. In England the AT-6A is known as the Harvard.



(Left) Setup for testing the plywood construction of the rear fuselage section and stabilizer of the North American combat trainer.

(Below) Wing section built of the new low carbon, low alloy steel for the North American combat trainer.



1942. But until then, the trainers will probably be about 150 lb. heavier than the original aluminum AT-6A, but that weight increase is safely allowable in view of the AT-6A's permissible design overload of 350 lb.

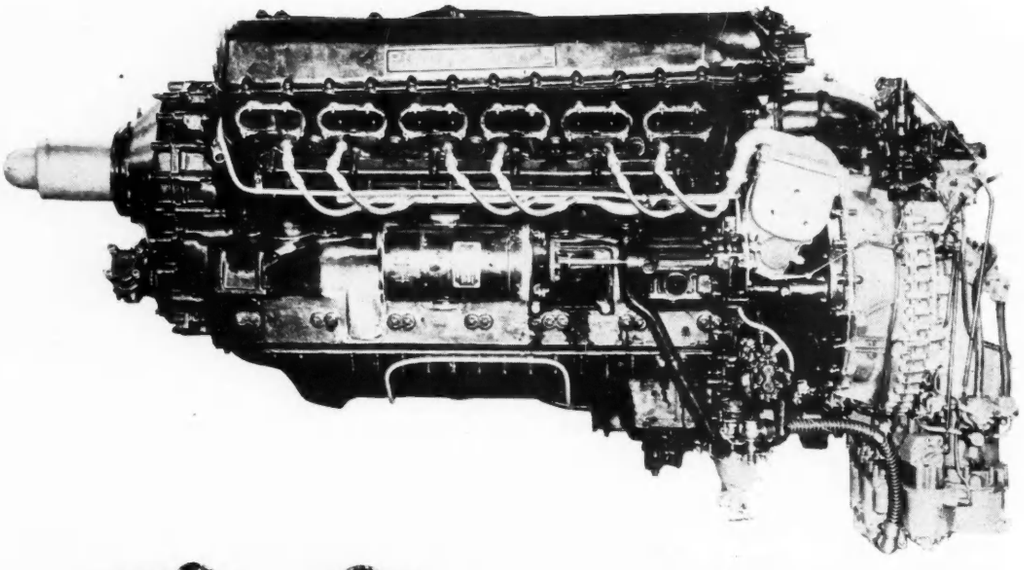
Approximately 250 lb. of aluminum will be conserved on each trainer by wooden floor boards, fuselage sections, fuselage side panels, horizontal stabilizers, and miscellaneous pieces of fairing and furnishings. An additional 996 lb. of this critical metal also will be saved per plane when low alloy steel wings, wing center sections, wing tips, vertical stabilizers, rudders, elevators, flaps, ailerons, and various pieces of cowling and fairing are introduced to the assembly line.

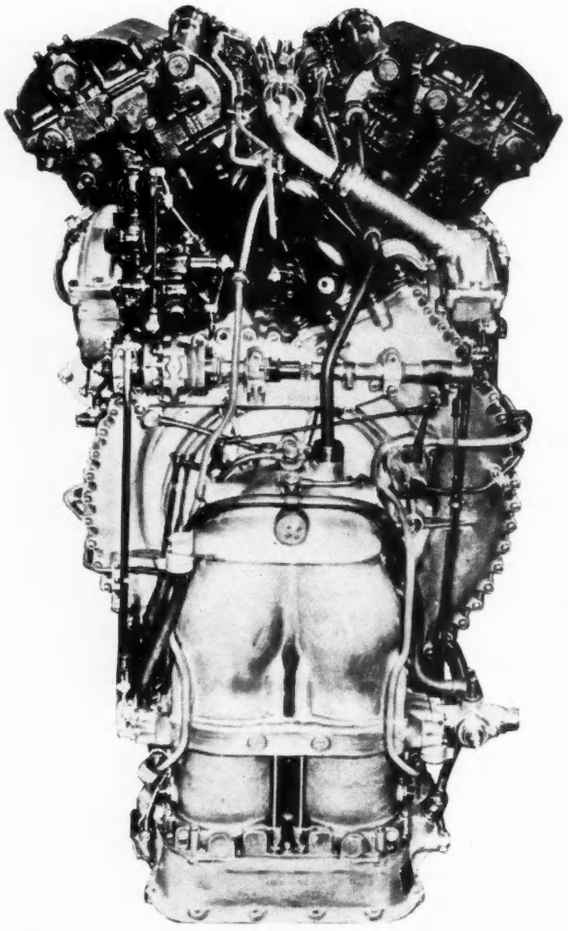
When large quantities of planes were ordered in 1940, it made possible more efficient tooling for mass production, but this advantage was offset by the wholly insufficient supply of aluminum alloy. It was then that North American Aviation began investigating substitutes, principally wood and steel. High alloy steels were out because they contained materials as critical as aluminum. Automobile body steel was

(*Turn to page* 66, *please*)

Britain's Rolls-Royce

By M. W. Bourdon
Special Correspondent
for AUTOMOTIVE and AVIATION
INDUSTRIES in Great Britain





Three views of the Rolls-Royce Merlin XX engine that supplies the power for many of Britain's fighters and bombers. There are 11,000 separate parts in it, consisting of 4500 different kinds of parts. (British official photos.)

THE Rolls-Royce Merlin XX engine is not the "Spitfire Merlin" so largely responsible for victory in the Battle of Britain, but a more powerful version of the same design, with its increase in performance gained chiefly from a more efficient two-speed supercharger and modifications in the carburetor, which make it somewhat longer and heavier. Its dry weight is 1450 lb., an increase of 8.5 per cent relative to the Merlin X engine, against which may be set an increase in power of 16.3 per cent at a height 18.3 per cent greater than the rated height of the earlier model. Its rated output of 1260 hp. compares with the rated 890 hp. of the Merlin I of 1936, but a better basis of comparison is gained between the Merlin X of 1938 (the "Spitfire Merlin") and the Merlin XX, as both of these engines are equipped with two-speed superchargers:

Merlin X—Maximum power (low gear), 1130 hp. at 3000 r.p.m. at 5200 ft.
Maximum power (high gear), 1010 hp. at 3000 r.p.m. at 17,750 ft.

Merlin XX—Maximum power (low gear), 1260 hp. at 3000 r.p.m. at 12,250 ft.
Maximum power (high gear), 1175 hp. at 3000 r.p.m. at 21,000 ft.

With a frontal area of 8.5 sq. ft. the Merlin XX, like the earlier types, has 12 cylinders and is an upright 60 deg., liquid-cooled engine arranged as a right-hand tractor. The bore and stroke are 5.4 in. and 6 in., respectively, making the piston displacement 1647 cu. in. Its b.m.e.p. is 202 lb. per sq. in. at rated power, with

Merlin XX Engine

an output of 0.765 hp. per cu. in. displacement and 4.56 hp. per sq. in. of piston area at a piston speed of 3000 ft. per min.

Each cylinder block is a single aluminum casting combined with head and coolant jacket, and is attached to the crankcase by 14 long studs extending through to the top of the block. Wet cylinder liners of a special grade of steel are used.

There are two intake and two exhaust valves per cylinder, operated by overhead camshafts and rockers. All valves are parallel with the center line of the block and have two concentric coil springs. Each camshaft is carried in seven forged aluminum bearing pedestals mounted on the top face of the cylinder casting. Camshaft drive is by bevel gears and inclined shafts, one at the rear of each cylinder block.

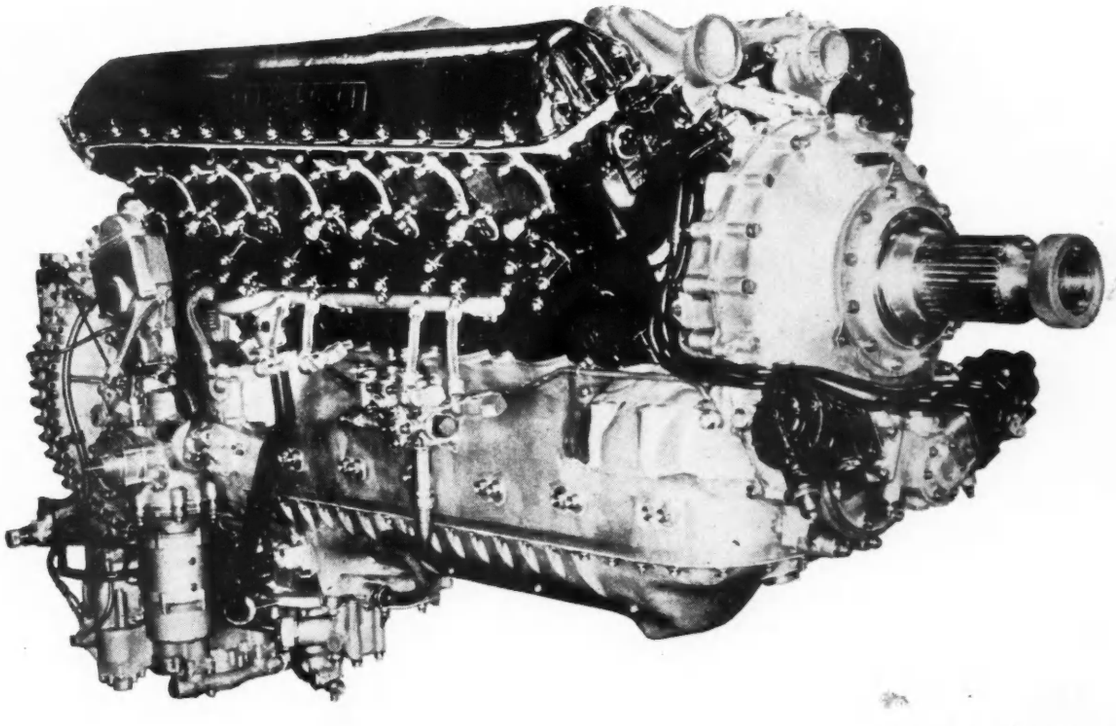
The valve seatings are screwed into the aluminum cylinder heads and the valve guides, cast-iron for the inlets and phosphor-bronze for the exhausts, have taper shanks and are pressed into the cylinder casting.

Bolted to the top half of the aluminum crankcase at the front end is the aluminum casing which houses the propeller reduction gear and its shafts and bearings. At the rear end is another casting known as the wheelcase, which carries gearing, bearings and shafts for the supercharger, magnetos, electric starter, generator, camshafts, coolant pump, and fuel pump. The supercharger and its driving mechanism are attached to the rear of the wheelcase and the carbureter is bolted to the rear of the supercharger. The lower part of the crankcase, a shallow aluminum casting, contains the oil pumps and filters.

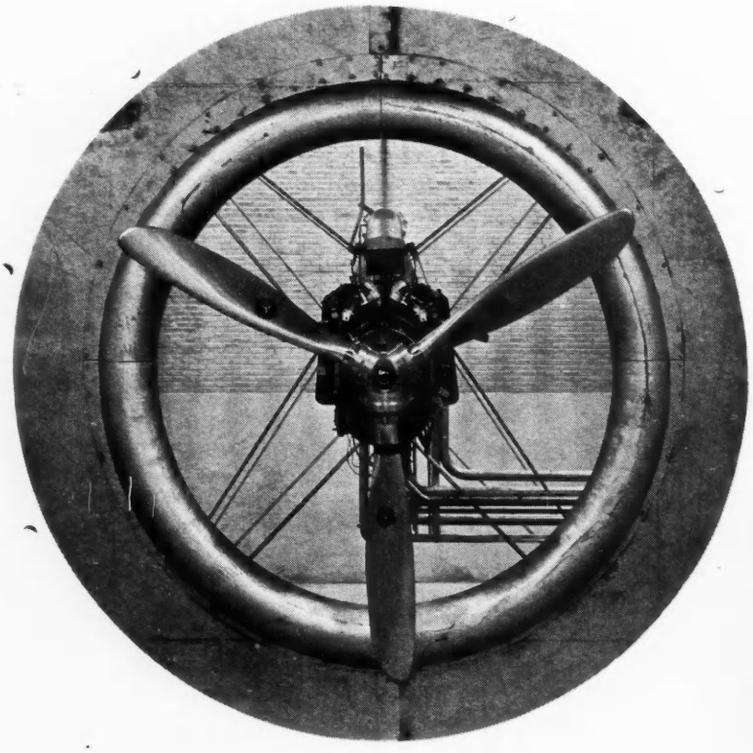
The hollow crankshaft at its forward end has a flange to drive the propeller reduction gear through a splined coupling. At the rear end the supercharger, magnetos, camshafts and other units are driven through the agency of a spring driveshaft. The crankshaft is carried in seven bearings, with lead bronze linings, supported by the top half of the crankcase. The bearing caps in addition to being held by the usual vertical studs, are carried between closely fitting cheeks in the crankcase casting, and transverse bolts pass through both the cheeks and the caps.

Connecting rods are H-section steel forgings, with lead-bronze lined steel bearing shells for the big-ends and the plain rod bearings, the latter supported on the outer surface of the forked rod blocks. Pistons are aluminum forgings with three pressure rings and two drilled scraper rings. Wrist pins float in the piston bosses.

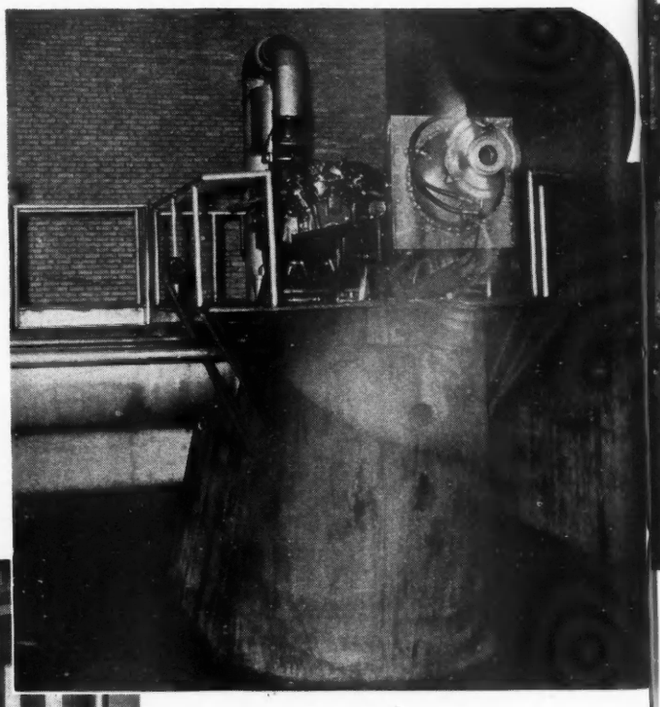
The supercharger gear shift mechanism is operated by the pilot through a servo deriving its power from scavenge oil pressure. Of the centrifugal type, the supercharger has a rotor produced from an aluminum forging and has a maximum operational speed around 29,000 r.p.m.



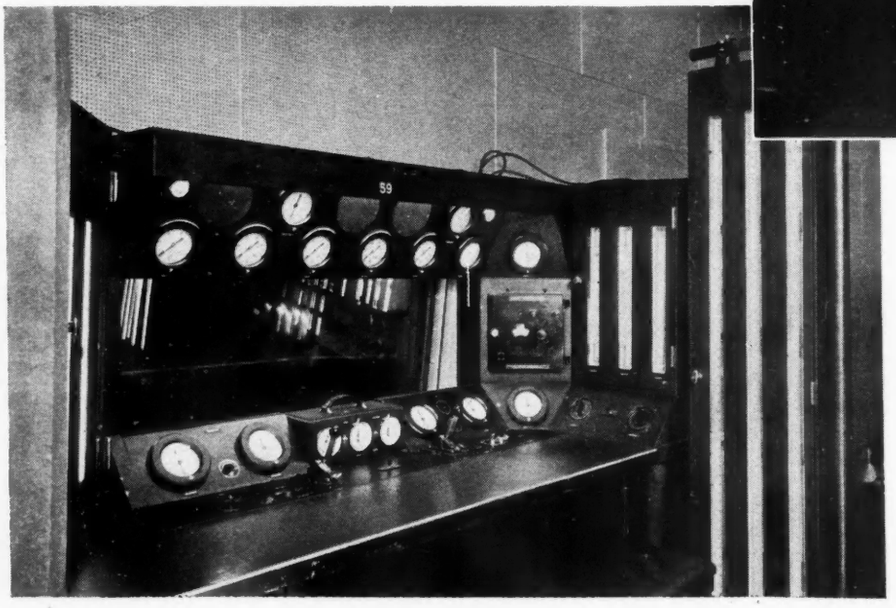
Allison Testing



For straightening the air flow through the propeller, Allison engineers have found this orifice plate quite effective in U-shaped test cells with vertical intake and exhaust stacks. The plate, located close to the trailing edge of the propeller blades, prevents back-flow of air in the stand and results in a higher air velocity in the cell. This setup is used for experimental tests when it is necessary to make a run over a lengthy period at high power output. Test propellers are the controllable pitch type

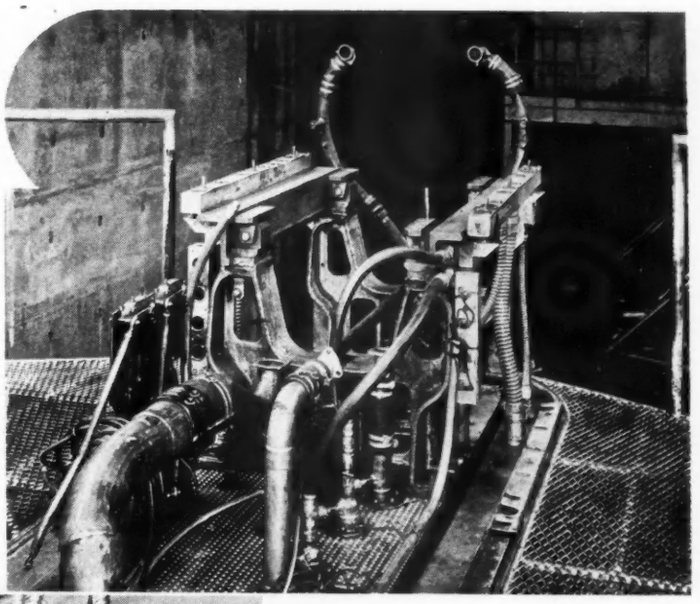


Because of greater rigidity and the absence of vibration in the operating range, thus resulting in low maintenance requirements, reinforced concrete construction has been adopted for all new production test stands, superseding the structural steel type

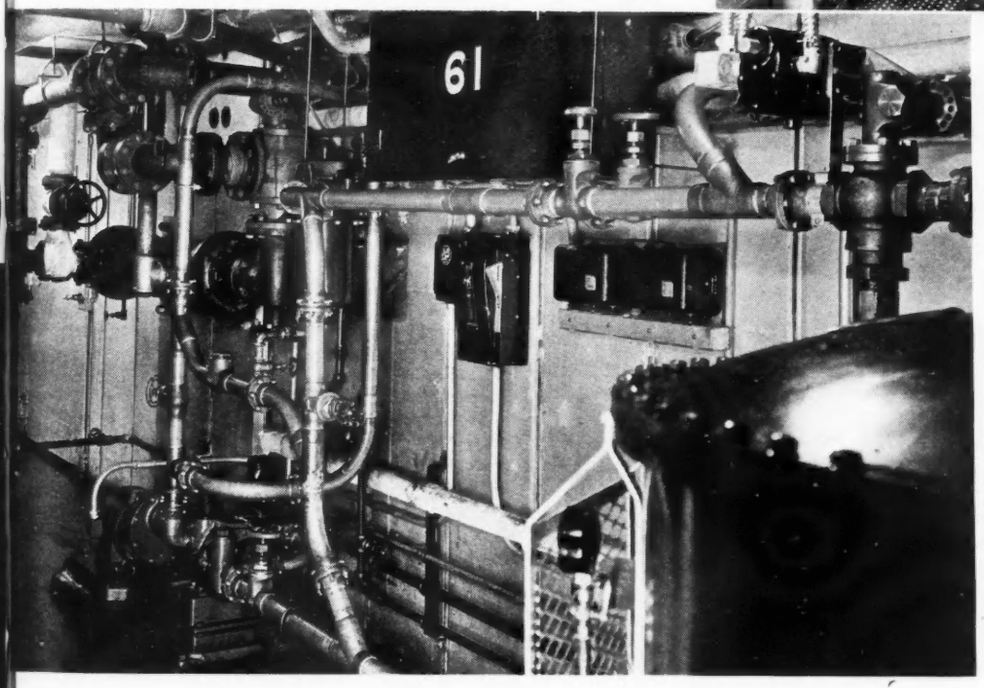


The Allison control desks incorporate such precision instruments and controls as manually balanced potentiometer with multi-point selector switch, mercury vapor thermometers, fluorescent illuminated manometers, hydraulic controls for throttle and mixture levers of carburetors, selector switches for temperature regulating valves, cable driven tachometer counter-timer unit, and warning devices for low fuel and oil pressures

Facilities

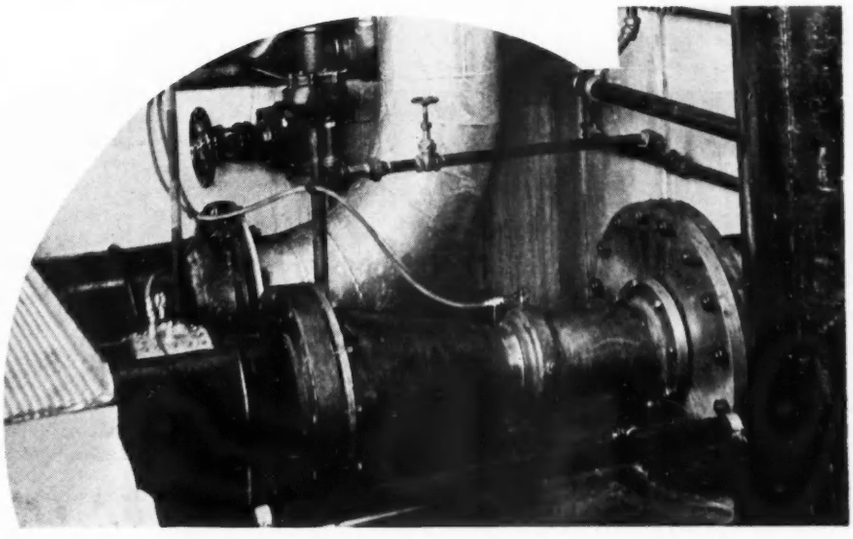


Mounts for Allison V-12 engines consist of cast iron bases and rubber bushings at four points. Simplicity of installation saves considerable time, only about 20 minutes being required to install or remove an engine with a normal crew

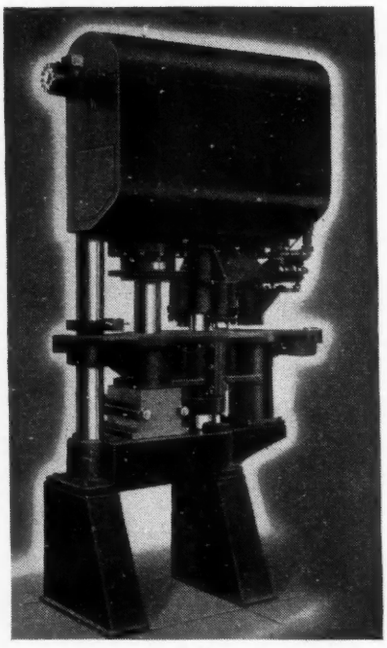


Under the test stand is this maze of operational equipment, comprising copper tube heat exchangers for regulating engine lubricating oil, glycol coolant and carburetor air temperatures. Bolted flange connections are used throughout the glycol and oil systems so that the piping can be disassembled easily for thorough cleaning. With a full flow filter in the oil system, two complete sets of lines are required to the engine

Air flow is measured with venturi meters, which make possible the use of one size of throat for engines requiring maximum air flows that vary as much as 30 per cent and yet permit sufficient accuracy in the low cruise power range. The short throat sections are accurately machined from brass castings and the expanding cones rolled from sheet metal



MEN and

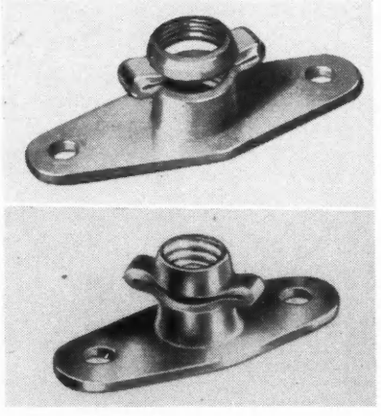


Much faster action is claimed for this 125-ton Watson-Stillman extrusion press which carries out the extrusion cycle while the operator is loading a second container.

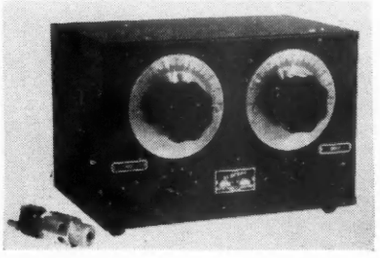
AN improved 125-ton extrusion press which permits simultaneous loading and extrusion has been developed by The Watson-Stillman Co., Roselle, N. J. The first of these units will extrude carbon mixtures, but the press is also suitable for extruding any plastic material. Since the press is fitted with two containers, it is possible for the operator to load one while the other is set in position for the extrusion cycle. The main ram is 12½ in. in diameter and has a 12-in. stroke. It advances at a speed of 54 i.p.m., presses at a speed of 6.4 i.p.m. at 2000 p.s.i. and returns at a speed of 150 i.p.m. Power is supplied from two Vickers pumps driven by a 5-hp. motor.

TWO new saddle-type turret lathes, to be known as the 3R and 4R, are shortly to be put into quantity production by the Gisholt Machine Company, Madison, Wis. Similar in design to the Gisholt 3L and 4L machines, the new models differ from each other only in capacity. Model 3R has a spindle bore of 5¼ in., carries a 21-in. chuck and provides a swing of 28½ in. over the ways; Model 4R has a spindle bore of 9¼ in., carries a 24-in. chuck and provides a swing of 31 in. over the ways.

A NEW process which enables users of latex for cementing, impregnating and coating to extend the volume of latex 50 to 300 per cent has been developed by the Union Bay State Co., Cambridge, Mass. The amount of extension depends on the use to which the latex is put. Blending of the filler material with the original latex is said to be so complete that the mixture responds to the same reagents, has the same wetting out properties and penetrates and dries in the same manner as the original latex. It is claimed that the process will make it possible to conserve present latex supplies.



For faster, easier riveting, the Boots Aircraft Nut Corp., New Canaan, Conn., has turned the "wing" angle 45 deg. on its wing-style self-locking nuts. By referring to the photographs the increased accessibility of the newest type nut (bottom) is easily noted.

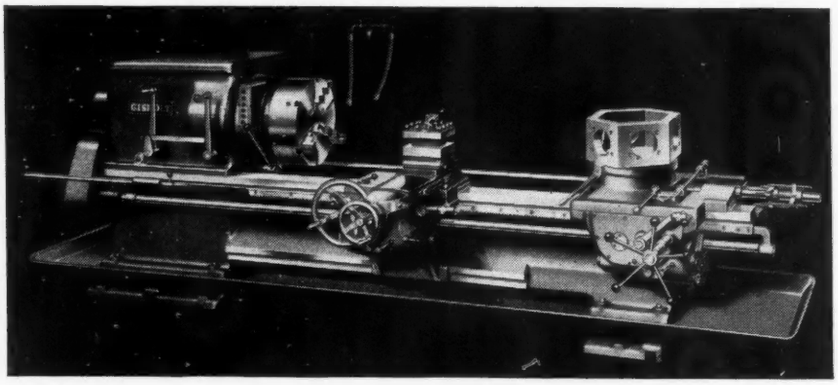


A new Electro detonation filter and pick-up providing means for selecting detonation or other explosion or vibration frequencies in automotive or aircraft engines has been developed by Electro Products Laboratories, Chicago, Ill. Model 2300 filter covers a range from 2000 to 8000 cycles; it can be used with Model 3000 pick-up and a cathode ray oscillograph to indicate immediately the presence of detonation.

DESIGNED primarily for use by the tool maintenance shops of plants using air hammers, the Burklyn test stand, built by the Burklyn Corp., Los Angeles, Cal., shows the three basic factors of performance—air consumption, force exerted by the hammer and blows per minute.

The stand, 40 in. wide, 24 in. deep and 58 in. high, incorporates a work table providing ample room for the testing and overhauling mechanic to perform repairs and adjustments. Since factory air pressure is supplied to the stand, a regulator on the instrument panel is provided so that a uniform testing pressure can be maintained. After the air is regulated to the desired pressure, it is sent through an accurate flow meter which indicates the volume of air consumed by the tool being tested. At the same time the force exerted by the tool and the number of blows per minute are shown on two separate gages.

The new stand is designed primarily for testing aircraft-type rivet hammers consuming a maximum of 40 cfm, and which are capable of driving aluminum rivets up to 7/16 in., and



This new Gisholt saddle-type turret lathe, offered in two sizes, is soon to be put into quantity production.

MACHINES

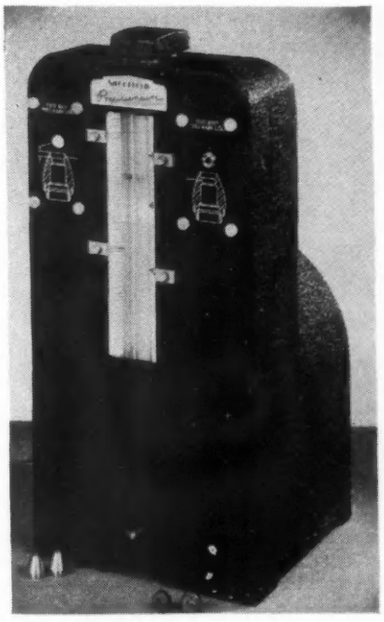
soft iron or dural rivets up to ⅜ in. in diameter. For larger hammers, flow meters and force gages of greater capacities can be provided.

As a substitute for steel in the manufacture of filing cabinets, the All-Steel-Equip Co., Aurora, Ill., is employing wood in the fabrication of two new lines. The Patriot file is made with the regular A-S-E Aurora 10-roller-bearing suspension cradles in four-drawer letter or legal widths; the Patriot Junior non-suspension file is fitted with four rollers under each drawer and is also furnished in both the letter- and legal-width four-drawer styles. All models can be supplied with general locks.

The Elastic Stop Nut Corp., Union, N. J., is offering its elastic-stop channel nuts for testing in the many applications in general industry where a multiple, self-locking, bolted fastening is required. Supplied with nut sizes ranging from No. 8 through ⅜ in., and with various nut spacings, the channels are easily riveted in position. As in all elastic stop nuts, the locking action is obtained with a vulcanized red fiber collar which forces the nut outward to create a constant metal-to-metal contact throughout the threads of the nut and bolt.

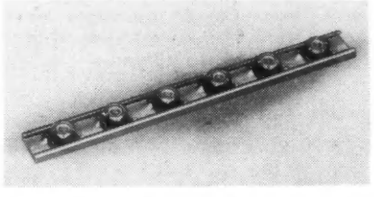
The Sheffield Corp., Dayton, Ohio, has announced the development of a new gage for checking simultaneously external or internal diameters and depths. The gage, known as the Precisionaire-Electrichek, combines in one housing the features of the Sheffield Precisionaire and the Multichek. One section of the gage, operating on the Precisionaire principle, measures the rate of flow of air passing between the gaging spindle and the internal diameter of the part being checked; the other section of the gage, operating as a Multichek unit, employs the regular reed mechanism gaging unit. Although both sections are independent of each other, they work simultaneously. Signal lights are used to expedite rapid inspection.

The gage is said to check to 50 millionths of an inch simultaneously. According to its makers the Precisionaire-Electrichek is the outgrowth of the development of other Sheffield instruments and is adaptable to many precision gaging operations.



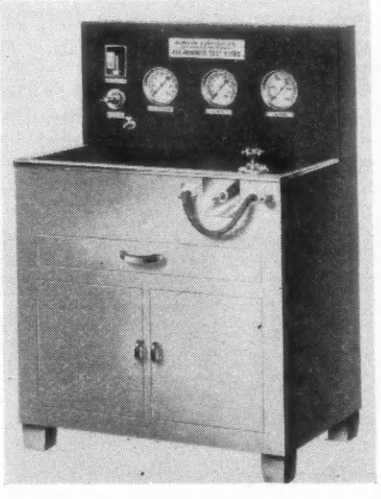
Newly developed by the Sheffield Corp., this Precisionaire-Electrichek is said to have numerous applications in the precision checking of small production pieces.

Since the present method of small shell production makes it necessary to bore out the nose end of a shell before threading or tapping, the Landis Machine Co., Waynesboro, Pa., has designed attachments for handling this type of work on its Landmaco machine. A special adapter supporting a replaceable-bit boring tool replaces the original die head, special serrated grips are employed for supporting the work and a special work support or cradle to align the work with the work grips is furnished. A hand-operated work stop aids in the location of the work with respect to the boring tools, and a lead screw feeds the work into the boring tool.

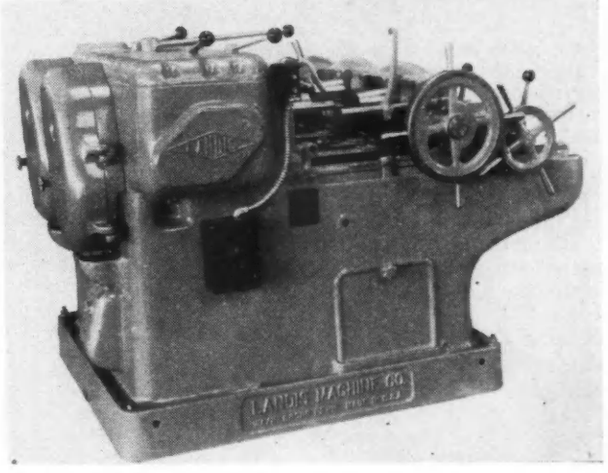


The Elastic Stop Nut Corp. manufactures these elastic stop channel nuts which can be adapted to many applications in general industry where a multiple, self-locking, bolted fastening is required.

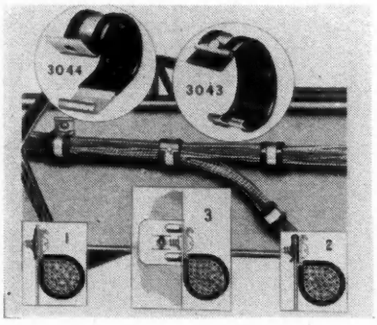
For faster attachment of wire bundles in aircraft assembly, two new series of Harness Speed Clamps have been introduced by Tinnerman Products, Inc., Cleveland, Ohio. Both types have latching means which permit hold-



Burklyn test stand designed for use in tool maintenance shops.



New attachments designed by its makers convert the Landmaco machine into a shell boring machine.

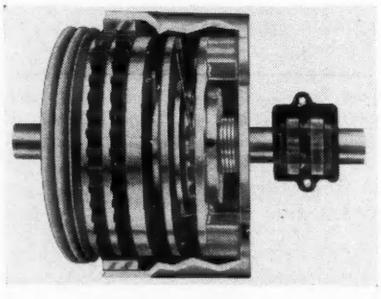


Illustrated above are the three methods of attachment for Tinnerman Harness Speed Clamps. The two types of clamps are shown in the upper part of the photograph.

ing bundles or groups of wires together during sub-assembly operations. Clamps in the 3043 series are used at intermediate locations; those in the 3044 series are used as supporting clamps for attachment to the main structure. The extruded plastic coverings are said to resist abrasion over 10 times longer than materials now used for wire cushions.

Both types of Harness Speed Clamps are available in 10 different sizes to accommodate bundles of wire in group diameters ranging from ¼ to 1½ in.

A MAGNETICALLY operated clutch possessing novel features together with simplicity has been patented by A. P. Warner, well known for the speedometer bearing his name. A clutch of this type has been in operation for the last two years at the Beloit, Wis., plant of the Warner Electric Brake Co.



By using a number of plates this type of Warner electromagnetic clutch is said to be well suited for operation in locations not easily protected from oil.

Incorporating features not found in any other type of clutch, the unit is said to be particularly well suited to numerous machine tool requirements. The wiring is simple, and because of the small amount of current required, the controlling apparatus is inexpensive. In the present installation the clutch is used to start a 6-ft. ball-bearing-mounted flywheel weighing 1500 lb. Control is so sensitive that the wheel can be made to revolve at a speed not over 10 r.p.m. Capacity of the clutch is estimated to be about 150 hp. at 900 r.p.m.

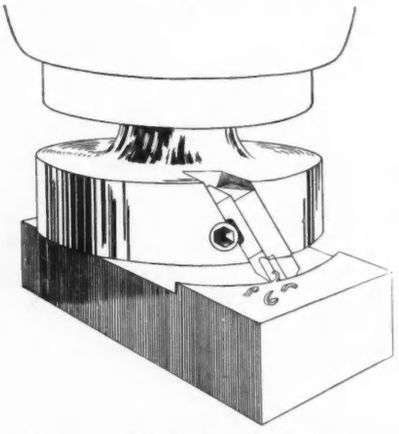
Other new developments are briefly described in the following paragraphs:

Quikcet Clamps

New Quikcet C-clamp designed for one-hand operation features ratchet jaw to permit quick setting. Manufactured by Grand Specialties Co., Chicago, Ill.

Time-saving Gear Cutter

"Slotmaster" attachment for milling machines permits economical gear forming at the bottom of a cavity in a machine part. Developed by Experimental Tool & Die Co., Detroit, Mich.



McKenna Metals Co., Latrobe, Pa., offers this single-bladed "Kennamill" which is designed for high-speed operation in machines normally fitted with hard-to-get, many-bladed cutters.

Electric Cable Connector

New Qiklug permits solderless connection of lug to cable. Furnished in eleven sizes for conductors from No. 14 to 2000M circular mils. Made by Burndy Engineering Co., Inc., New York, N. Y.

Solder-flushed Contacts

Contacts flushed on one side with silver solder permit brazing in electric welder. Eliminate extra operation of placing solder sheet between contacts. Made by Gibson Electric Co., Pittsburgh, Pa.

Scales for Aviation Industry

Scales for checking aircraft piston rings and rods. Announced by Toledo Scale Co., Toledo, Ohio.

High-strength Solder

Special solder for aluminum, Dowmetal, Almico, etc., developed by Lloyd S. Johnson Co., Chicago, Ill.

Plastic Floor Material

Oil-resistant floor resurfacer can be applied without interruption of floor traffic. Made by the Flash-Stone Co., Philadelphia, Pa., manufacturer.

Dry Stickers

Kum-Kleen dry identification stickers for defense industries. Offered by Avery Adhesives, Los Angeles, Calif.

Air Raid Truck

Truck built to carry necessary equipment for handling incendiary bombs. Offered by Service Caster & Truck Co., Albion, Mich.

Pilot Seats

Pilot seats molded from canvas impregnated with Catalin phenolic laminating varnish. Effect saving in weight and dispense with use of aluminum. Manufactured by Capac Manufacturing Co., Capac, Mich.

Tubing Protectors

Inexpensive metal caps for protecting plain and beaded tubing from handling knocks. Announced by Tubing Seal-Cap Inc., Los Angeles, Calif.

Steel Frame Trailer

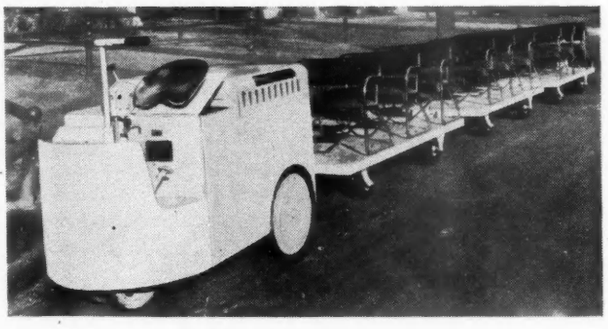
Trailer for industrial trucks has 3000-lb. capacity, all-steel framework, and wooden deck. Length: 80 in.; width: 36 in.; height: 14 in. Built by Rocky Mountain Steel Products, Inc., Los Angeles, Calif.

DOALL Supply Cabinet

Useful in storing saws, files, and other materials used on DOALL machines. Space to store 8000 ft. of saw in 100-ft. rolls. Manufactured by Continental Machines, Inc., Minneapolis, Minn.

(*Turn to page 64 please*)

For passenger transportation within large industrial units, the Mercury Mfg. Co., Chicago, offers a new combination of the Mercury A-540 electric "Tug" and modified A-310 trailers. Coupling is effected by means of the Mercury Safety-Self-Coupler.



Auto Unions Push Victory Programs

UAW-CIO Leaders Sponsor Equal-Sacrifice Victory Plan; Others Take Similar Steps; Some Independents Dissent

Pushing its campaign for "Victory Through Equality of Sacrifice," the UAW-CIO has run full-page advertisements in 16 daily newspapers throughout the country with a combined circulation of 5,890,000 readers. The campaign also will be supported by radio programs and outdoor advertising. The 10-point program was drafted at a war emergency conference of union delegates in Detroit which went on record as waiving double time pay for Sunday and holiday work and time and one-half for Saturdays when it comes within the normal five-day work week.

Under the final point of the program, the UAW-CIO agrees to take its overtime pay beyond 40 hours per week in non-negotiable special defense bonds if the other nine provisions are adopted by the government and business. Although indications from Washington are to the effect that some of these measures may be adopted during the war emergency, others of these provisions seem very remote. The first nine points of the program are: an end to all profiteering by limitation of profits to 3 per cent return on invested capital; limitation of income to an individual or family to $25,000 per year during the war emergency; halting inflation by fixing a price ceiling on food, rent, clothing and other necessities to assure their fair distribution; rationing of all food, clothing, housing, and other necessities; adjustment of wages to the increased cost of living, bringing "real" wages to the 1941 level; guarantee of a living wage to dependents of men and women in the armed forces; a moratorium on the debts of all those unemployed through conversion to war industry and of those in the armed forces; creation of a labor production division of the WPB to increase output, and post-war planning to avoid a catastrophic depression after the war.

Reassuring the union conference on the premium pay issue, President Roosevelt wrote R. J. Thomas, UAW-CIO president, "It is the intention of the government to re-negotiate contracts with the employers wherever necessary to ensure that the savings from the relinquishment of double or premium time go not to the employer but to the Nation." Buick Local 599 in Flint is the only UAW-CIO local so far which has rejected the waiver of premium weekend pay. According to the local president, the members were opposed to relinquishing any overtime provision existing in present contracts. However, with other General Motors locals favoring the change, it likely will be embodied in the revised GM contract. The UAW-AFL international board, which holds bargaining rights in a few automotive plants, also voted in favor of giving up of weekend premiums. However, the Society of Tool and Die Craftsmen, an independent union with 12,000 members, went on record as opposing any sacrificing of weekend premium pay, its president maintaining that it had fought for this privilege for years and that its members often worked only five or six months out of the year.

Cost of paying premium wages for weekend work to the government and eventually the taxpayers was indicated

(*Turn to page* 54, *please*)

Cancel SAE Summer Meeting

The 1942 SAE Summer Meeting is definitely cancelled according to a recent announcement by the Society. Originally scheduled to be held at The Greenbrier, White Sulphur Springs, the meeting will not be held because of the presence of enemy diplomats at The Greenbrier and the inability of the railroads to guarantee sufficient Pullman cars for the transportation of SAE crowds.

As a substitute plan the SAE Council has decided to stress the importance of regional meetings and to include many of the important papers in the Society's publications.

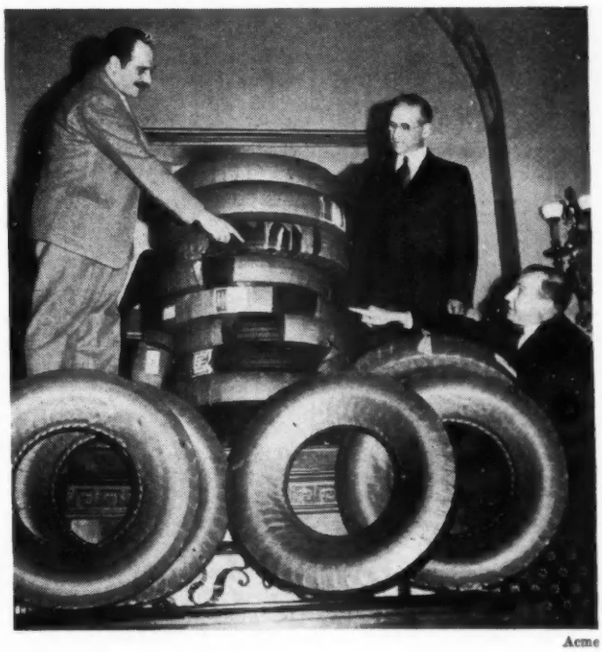
New Packard President

Geo. T. Christopher, formerly vice-president in charge of manufacturing, has been elected president of the Packard Motor Car Co. Christopher started in the automobile industry in 1917 as shop superintendent of the Standard Manufacturing Co.

He succeeds M. H. Gilman, who resigned because of ill health following injuries suffered in an automobile accident. He also was elected to the board of directors along with Joseph M. Dodge, president of the Detroit Bank.

Two Ounces of Crude in "Victory" Tires

Members of the House Interstate and Foreign Commerce Committee were presented with 18 "victory camelback" tires, each retreaded with five pounds of reclaimed rubber and two ounces of new rubber. Retreaded under government supervision, the tires are expected to give up to 10,000 miles of service. Left to right are: Elliott E. Simpson, New York City rubber dealer who presented the tires; Chairman of the Committee, Rep. Clarence F. Lea; and Rep. Pehr G. Holmes, Mass.



Acme

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Cast-Hull Tank Under Test

Fitted with a new all-cast hull, the Army's M-4, pictured sans guns in an earlier issue of Automotive and Aviation Industries, is shown undergoing its first tests by the Armored Force Board. Weighing approximately as much as the M-3, this model carries a battery of machine guns in addition to the 75-mm gun mounted in the center of its lower, full-swinging, streamlined turret.

Treated Steels Replace Scarce Alloys

Results of Automotive Research Lighten Burden of Finding Substitutes, Show Way to Efficient Scrap Collection

by W. C. Hirsch

More and more special steels are being developed in response to the needs of the aviation industry. It is only natural that, mindful of the necessity of conserving the supply of some of the imported alloy metals, metallurgists should aim chiefly at the bringing out of steels which owe their special properties to carburizing, quenching, and other forms of heat-treatment.

Frequent reference is made these days to the growing closeness of the steel industry to the manufacture of aircraft. Some do not realize, however, that the task confronting metallurgists at this time has been immeasurably lightened through studies of heat treatment carried on in the country's automotive plants since World War I. This is the bridge that has made possible the ease with which the present-day problems are being solved.

The rapid return to usefulness of scrap, which is so necessary these days, is being intensified, the groundwork for systematic conservation having been laid in the automotive industry twenty-five years ago. Methods and installations for the daily collection of turnings, borings, and other machine scrap, of which one reads a great deal these days, are but an extension of the standard procedure followed in automotive plants.

So long as the tonnage of finished steel needed in the prosecution of the war continues at or near the present rate, the supply of both basic iron and scrap is certain to be under heavy pressure. Much publicity has been given recently to a report that some steel producers are using as much as 70 per cent pig iron in furnace charges that formerly consisted one-half of scrap and in some cases had even a higher scrap content.

Iron ore production and transportation, although surpassing all records, are still being stepped up, and it is this increase in output, which from now on apparently will contribute more to the easing off in the tight basic material situation than scrap. It may be well to sound a warning in connection with this development against creating the impression that the quality of steels will be enhanced by the use of more pig iron and less scrap. Steel mill practice has been improved to the point where the percentage of scrap which they used in their charges in pre-war times yielded all the properties that the most exacting buyer sought in a certain description of steel. It is just that piles of suitable scrap have shrunk and that collection of non-industrial scrap is becoming more difficult, so that, at least for the time being, the use of more pig iron will be helpful.

Whether this will have any effect on post-war practice is a question that can hardly be answered while the war

(*Turn to page* 60, *please*)

Battery Program Limits Production and Sales

The War Production Board has announced a program to conserve substantial quantities of lead, antimony, rubber and other critical materials going into the manufacture of storage batteries for passenger automobiles and light trucks. The program:

Prohibits production of these batteries after April 30 except in specified minimum ampere hour capacities, thereby reducing the number of sizes and models now being produced from about 75 to 15;

Curtails production by each manufacturer during the six months from April to September 30 to 75 per cent of the number of batteries sold by him during the corresponding period of 1941;

Orders retailers to cease selling or delivering after April 30 any new replacement battery to any purchaser unless the purchaser turns in a used battery at the time of the transaction;

Places rigid restrictions on inventories of producers, retailers, jobbers, and warehouses, in order to avoid tying up critical materials.

Limit Benzene Use

The War Production Board has stopped the use of benzene in motor fuel because it is a necessary ingredient of synthetic rubber. An exception is that any producer or distributor may use within the next 30 days one-sixth of the amount he used for the three months ended March 31. Benzene is added to motor fuel as an anti-knock ingredient, either in addition to or in place of tetraethyl lead. It is a principal source of styrene, one of the main ingredients of Buna rubber.

The Order specifically exempts benzene used in the production of aviation fuel with an octane rating higher than 87.

CALENDAR

Conventions and Meetings

Assoc. of American Battery Manufacturers Spring Meeting, Cincinnati, May 7 and 8

American Management Association, New York, Spring Production Conference .....May 13-14

Natl. Metal Trade Association, Annual Convention, New York City, May 19-20

American Iron & Steel Institute New York City—Annual Mtg. .....May 21

American Society of Mechanical Engineers, Semi-Annual Meeting, Cleveland, Ohio .....June 8-10

American Society for Testing Materials, Atlantic City, Annual Mtg. ..June 22-26

National Petroleum Association, Atlantic City, Annual Mtg. .....Sept. 16-18

Natl. Metal Congress & Exposition, Detroit .....Oct. 12-17

American Society for Metals, Detroit, Annual Mtg. .....Oct. 12

American Welding Society, Detroit, Annual Mtg. .....Oct. 12

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Continued fluctuating trends of general business activity are reported. The index of *The Journal of Commerce,* without adjustment for seasonal variation, for the week ended April 18 stands provisionally unchanged at 120.8 per cent of the 1927-29 average, as compared with 109.9 a year ago. The adjusted index of *The New York Times* for the week ended April 11 was 132.5 per cent of the estimated normal, as against 136.0 for the preceding week.

Department store sales during the week ended April 18, as reported by the Federal Reserve Board, were 15 per cent above those a year ago. For the four weeks then ended the comparable gain was 12 per cent, with total sales in 1942 to that date 22 per cent ahead of the similar turnover last year.

Railway freight loadings during the week ended April 18, the largest weekly number since last November, totaled 846,562 cars, 4 per cent above the figure for the week before and 19.4 per cent greater than the number a year ago.

Bank debits in leading centers during the thirteen weeks ended April 15 were 14 per cent larger than the total a year earlier. The increase outside New York City was 19 per cent.

Electric power output during the week ended April 18, registering further decline, was 14.2 per cent above that a year ago, as against a corresponding gain of 14.3 per cent shown a week earlier.

Crude oil production in the same period averaged 3,545,000 barrels daily, 1600 barrels above the figure for the preceding week but 121,800 barrels less than the output recommended by the Office of the Petroleum Coordinator.

Bituminous coal production in the week ended April 11 averaged 1,883,000 tons daily, as against 2,019,000 tons for the week before and 200,000 tons a year ago, when most operations were suspended.

Engineering construction contracts awarded during the week ended April 23 amounted to twice the corresponding sum last year, with the total so far in 1942 about 47 per cent greater than the aggregate a year earlier, according to *Engineering News-Record.*

Professor Fisher's index of wholesale commodity prices for the week ended April 17 stands at 105.6 per cent of the 1926 average, as compared with 105.4 for the preceding week and 89.7 a year ago.

Member bank reserves declined $32 million during the week ended April 22, and estimated excess reserves dropped $140 million to a total of $2,750,000,000.

Rubber, Plastics Meeting

The Detroit Rubber and Plastics Group has arranged a meeting for May 8 at which Dr. A. A. Sommerville of the R. T. Vanderbilt Company of New York will speak on the subject: "Latest Dope on Synthetic Rubber as Related to Accelerators & Plasticizing and High Temperature Testing." This meeting will be held at the Detroit Leland Hotel, Detroit, Mich.

Battery, Rubber and Truck-Trailer Committees Formed

The formation of an Automotive Battery Industry Advisory Committee has been announced by the WPB Bureau of Industry Advisory Committees. R. L. Vaniman is government presiding officer. Committee members are:

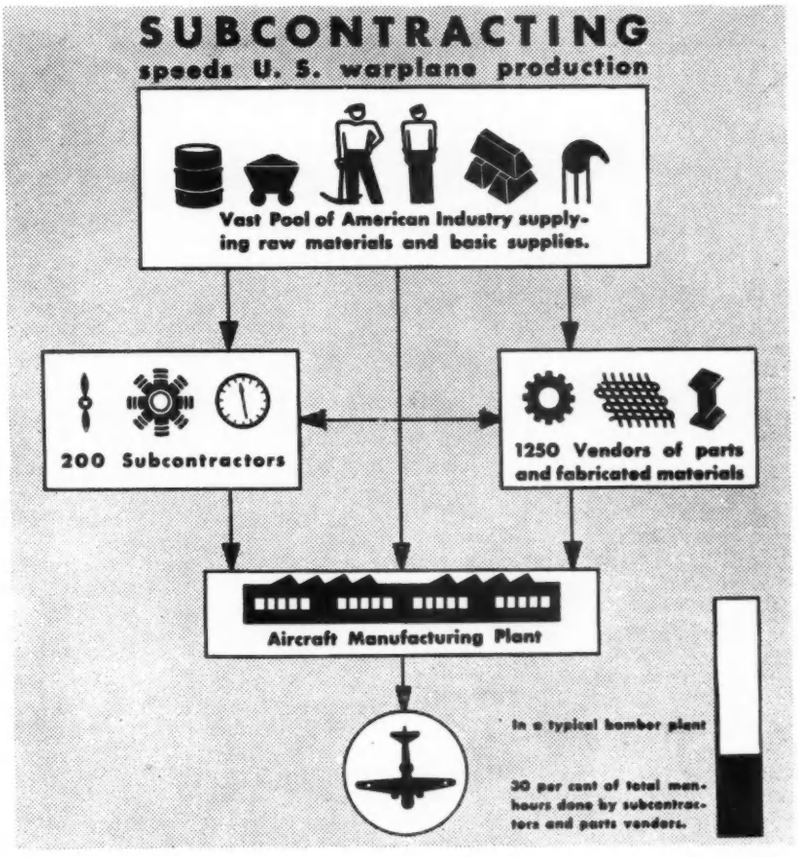
A. J. Baracree, Am-Plus Storage Battery Co., Chicago; Edward Becker, Merry-Bean Co., San Francisco; G. W. Douglas, Douglas Battery Mfg. Co., Winston-Salem, N. C.; E. T. Foote, Globe-Union, Inc., Milwaukee; A. Foster, Battery Division, Norwalk Tire & Rubber Co., Norwalk, Conn.; J. H. McDuffee, The Electric Auto-Lite Co., Toledo, Ohio; B. F. Morris, Thomas A. Edison, Inc., Kearney, N. J.; Lester Perrine, Perrine Quality Products Corp., Waltham, Mass.; Arthur G. Phelps, Delco-Remy Division, General Motors, Anderson, Ind.; W. F. Price, Price Battery Corp., Hamburg, Pa.; L. B. Raycroft, The Electric Storage Battery Co., Philadelphia; G. W. Taylor, American Battery Co., Nashville, Tenn.

The bureau has also announced the formation of a Mechanical Rubber Goods Industry Advisory Committee. C. S. Reynolds is government presiding officer. Committee members are:

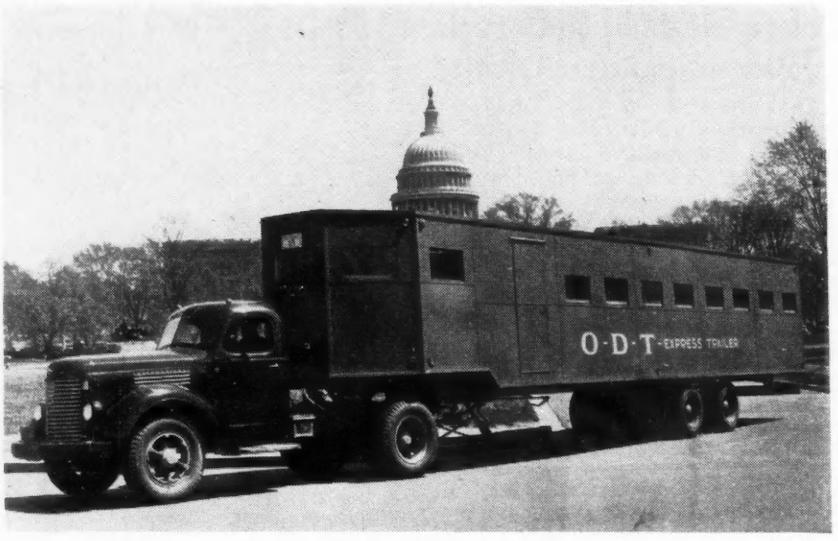
Willard H. Cobb, U. S. Rubber Co., New York City; F. M. Daley, Sponge Rubber Products Co., Derby, Conn.; J. E. MacDonald, Jr., Whitehead Brothers Rubber Co., Trenton, N. J.; K. H. Glanton, Dayton Rubber Manufacturing Co., Dayton, O.; W. S. Richardson, B. F. Goodrich Co., Akron, O.; Franklin G. Smith, Ohio Rubber Co., Willoughby, O.; W. L. White, Raybestos-Manhattan, Inc., Passaic, N. J.; C. W. Yelm, Gates Rubber Co., Denver, Col.; H. P. Schultz, Republic Rubber Co., Youngstown, O.; Paul H. Henkel, Continental Rubber Works, Erie, Pa.; D. E. Harpfer, Goodyear Tire & Rubber Co., Akron, O.; George L. Abbott, Garlock Packing Co., Palmyra, N. Y.; J. H. Hayden, Hewitt Rubber Corp., Buffalo, N. Y.; A. F. Matheis, Thermoid Co., Trenton, N. J.

A Truck Trailer Industry Advisory Committee headed by R. L. Vaniman consists of the following:

Harvey C. Fruehauf, President, Fruehauf Trailer Co., Detroit, Mich.; Bert P. Bates, Director, Commercial Division, Highway Trailer Co., Edgerton, Wis.; M. N. Terry, Vice-President, Trailmobile Co., Cincinnati, O.; W. C. Nabors, President, W. C. Nabors Co., Mansfield, La.; M. J. Neeley, President, Hobbs Manufacturing Co., Fort Worth, Tex.; Harrison Rogers, Assistant Treasurer, Rogers Brothers, Albion, Pa.; N. A. Carter, President, Carter Manufacturing Co., Memphis, Tenn.; Harry N. Brown, President, Keystone Trailer & Equipment Co., Kansas City, Mo.; Christopher Hammond, Jr., Vice-President, Steel Products Co., Savannah, Ga.; H. C. Bennett, President, Utility Trailer Manufacturing Co., Los Angeles, Calif.; A. R. Trombly, President, Trombly Truck Equipment Co., Portland, Ore.; C. H. Kingham, President, Kingham Trailer Co., Louisville, Ky.; J. L. Glick, President, Truck Engineering Co., Cleveland, O.; F. H. McIntyre, President, Carolina Truck & Trailer Co., Charlotte, N. C.; Myles Standish, President, Omaha Standard Body Corp., Council Bluffs, Iowa.; J. C. Farrell, Vice-President, Easton Car & Construction Co., Easton, Pa.; G. A. Burns, Manager, Oil Equipment Division, Butler Manufacturing Co., Kansas City, Mo.


SUBCONTRACTING
speeds U. S. warplane production
Vast Pool of American Industry supplying raw materials and basic supplies.
200 Subcontractors
1250 Vendors of parts and fabricated materials
Aircraft Manufacturing Plant
In a typical bomber plant
30 per cent of total man-hours done by subcontractors and parts vendors.

In a recent analysis of the part played by subcontractors in warplane production, investigators found that thirty per cent of the parts going into a particular plane were manufactured by subcontractors. Reference to the chart shows the number of outsiders making up this percentage of parts.



Acme

ODT Worker Transport

As one answer to the problem of transporting workers from central points in large cities to outlying industrial plants, the Office of Defense Transportation has approved the design of this trailer which is built almost entirely of non-critical materials. Consisting of a conventional steel frame with a plywood and Masonite superstructure, the trailer carries 141 passengers. Even though heralded as a solution to a grave problem, this type of trailer has been rejected by the Detroit Department of Street Railways, and has been turned down flatly by one company engaged in war production in that area. According to one official: "They have no head room, they weave around on the highways, and quickly become filled with gas. They would be dangerous to ride in. Further, ask a man to work ten hours a day and then bounce home in a cattle car and your workman would be no good at all the next day."

OPA Permits 16% Tire Price Increase

Permission for price increases to cover the cost of the Government's tire return plan, which was set up to check "bootlegging" and to relieve retailers and jobbers of the financial burden of carrying large stocks in a shrunken market has been granted by Price Administrator Leon Henderson.

Maximum retail prices for new tires and tubes of passenger car sizes are increased 16 per cent. Manufacturers and mass distributors will be permitted to advance their wholesale prices by the actual dollar amounts of the 16 per cent increases in the retail ceilings. They have been notified that the voluntary maximum price agreement with the OPA has been relaxed to allow for the advances which took effect April 25.

No Tool Show in '43

Because of the need of putting all tools into immediate production there will be no Machine & Tool Progress Exhibition in 1943, the board of directors of the American Society of Tool Engineers decided at the annual meeting at St. Louis. For similar reasons the 1942 Tool Show was not held last month.

New Forging Plant

A plant which will increase by millions of pounds monthly the aluminum forgings necessary to expand aircraft output in the United States will be erected by Chevrolet, it was announced recently by M. E. Coyle, general manager. The new government-authorized plant, one of the largest of its kind in the world, will be built on land adjoining another Chevrolet war production unit.

WPB Ups Buna Allowance

The War Production Board has authorized the Reconstruction Finance Corp. to provide facilities for an annual productive capacity of 700,000 tons of Buna S synthetic rubber to be in operation not later than the end of 1943. This represents an increase of 100,000 tons in the Buna S program previously authorized by the WPB.

George H. E. Petersen

George H. E. Petersen, 62, factory manager of the Graham-Paige Motors Corp., died April 8 at Detroit after a long illness. He was one of the five founders of the Paige Motor Car Co. in 1909.

Junked Salvage Process Speeds Scrap Production

The bottleneck in conversion of millions of junked automobiles throughout the country into scrap metal may be solved by a new process announced in Buffalo by the National Smelting, Refining and Machinery Corp.

The new process was recently demonstrated at a private meeting of steel men, metallurgists, foundrymen, government representatives, and others at the Hetzler Foundry in Rochester, N. Y.

In the experiment, six old automobiles, stripped only of tires, batteries, and radiators, were melted into scrap metal in an ordinary cupola furnace. The process, patented by the Universal Research Corporation of Kenmore, N. Y., is believed to be the first to meet with success in reducing junked automobiles to scrap in the course of minutes.

With the attention of the country's industrial leaders today focused on scrap so greatly needed for the war effort, the general approval accorded the process assumed national importance.

Plans are now being completed for the construction in Buffalo of the first of ten or more smelting plants to be built throughout the country. The plants will use the new technique. The Buffalo plant will turn out scrap iron in pig form, principally from "junked" automobiles gathered from auto graveyards in the Buffalo area.

The plant will be equipped with six specially designed cupola furnaces and it will be capable of converting cars into iron at the rate of 1000 tons every 24 hours. This would represent 1000 cars.

Under the plans, the cupolas would be the tallest ever built. Rising to a height of 108 feet, the twelve-foot-diameter stacks are designed to receive old machines at the rate of one every five minutes.

Walter F. Lockwood, temporary president of the new company, explained the operation as follows:

"The entire automobile is placed in the top of a cupola stack high enough to hold about eight cars. By utilizing the pressure from the stack of cars and the heat from the melting zone, which gradually will consume the inflammable parts, the cars will be ready for the furnace when they reach the bottom. As one machine collapses at the bottom of the stack, room is made for another at the top."

Mr. Lockwood estimated there are about 5,000,000 junked cars in auto graveyards of the country and probably 10,000 or more in the Buffalo area alone. Many now are being prepared for shipment to the steel plants but it was pointed out that the ordinary method of cutting up an old automobile with acetylene torches is extremely slow and expensive compared with the new process.

ODT Orders Truck Use Curtailment

A general order has been issued by the Office of Defense Transportation curtailing local delivery services 25 per cent as a means of conserving transportation facilities and equipment. The order also requires common, contract and private over-the-road haulers to place freight operations on a more efficient basis. Regulations concerning local deliveries become effective May 15. Over-the-road regulations become effective June 1. Suggested procedure affecting the latter includes staggering schedules, exchange shipments, pooling, joint terminals, lease and exchange of equipment, etc.

British Combine

Observation Post

A worker is shown fitting the observation cupola in its position above the pilot's cockpit on a Handley Page "Halifax" bomber. From this point it is possible to check on enemy operations and to take important navigational readings.

MEN . . . . . .

George A. Meyrer and **Mundy I. Peale** have been elected vice-presidents of Republic Aviation Corp. and will direct certain expansion activities of the corporation.

William G. Zink will be in charge of a new branch office in Dallas, Texas, of The B. F. Goodrich Co.

George G. Raymond, Jr., has been elected assistant treasurer of Lyon-Raymond Corp.

Warren H. Clarke has resigned as State Director for Michigan of the War Production Board to accept a position as assistant general manager of the Houde Engineering Division of Houdaille-Hershey Corp. He succeeds the late Frank R. Schubert.

Robert Grant has been appointed vice-president in charge of manufacturing of the Young Radiator Co.

E. A. Stevens, formerly managing director of Goodrich's buying subsidiary in Singapore, has been named assistant to the director of purchases and **H. C. Bugbee** has been appointed manager of the crude rubber division of The B. F. Goodrich Co.

J. H. Matthews and **O. H. Cilley** were elected to the Board of Directors of Raybestos-Manhattan, Inc.

J. H. Coolidge, treasurer, has been elected a director of Thompson Products, Inc.

Mrs. Josephine Gomon, former secretary of the Detroit Housing Commission, has been named supervisor of women's personnel at the new Ford bomber plant.

Harry C. Butkiewicz, vice-president of Universal Credit Co., has been appointed chief consultant to the OPA in Washington.

J. A. Wilkin has been appointed district sales manager for the southeastern states by Champion Spark Plug Co.

Joseph D. Burke, formerly sales manager of the Dodge Truck Division of Chrysler Corp., has joined the All Metal Products Co., of Wyandotte, Mich., on war work.

Courtland S. Gross, president of Vega Aircraft Corp., has been elected a director of Lockheed Aircraft Corp., succeeding **L. C. Ames,** who resigned to enter the Army.

Burnham Litchfield, formerly vice-president and general manager of the Allied Aviation Corp., has been named sales manager of Duramold Aircraft Corp.

Named members of an advisory committee to Secretary of Commerce Jesse Jones on the growth of plantation rubber in the Western Hemisphere and Africa are **Arch Johnston,** formerly manager of the Ford Motor Co. rubber plantation in Brazil; **F. B. Davis, Jr.,** president of U. S. Rubber Co.; **Harvey Firestone, Jr.,** president of Firestone Tire & Rubber Co.; **John Collyer,** president of B. F. Goodrich Co., and

(*Turn to page* 50, *please*)

OPA Announces Car Census Figures

The number of new automobiles available for rationing this year is about 60,000 larger than the 340,000 originally indicated by manufacturers' reports, an official count by the Office of Price Administration shows.

Passenger car figures received by OPA in a close count of inventory show 399,565 new cars in the hands of dealers, distributors and manufacturers as of February 11, 1942. This is in addition to the Government "pool" stocks held by them. The inventory has not yet been completed and the final count of non-pool cars probably will exceed 400,000.

The 340,000 figure which until now has been used as the inventory of new passenger cars (over and above the estimated 140,000 held in the Government pool for military needs and rationing in 1943) was arrived at on the basis of reports by manufacturers. These reports included inventory figures submitted to the manufacturers by dealers, some of whom, it is thought, may have understated their stocks in the hope of getting more cars.

Check-up on the original figure for the pool car inventory also is under way, but returns so far are not sufficient to indicate what change, if any, there may be from the 140,000 total now used as the number of new cars in the pool. The Government pool is made up of new passenger cars which had not been shipped by the manufacturers prior to January 16, 1942, to an agency other than one controlled by the manufacturer. Hence, the original count is considered more likely to be accurate, and no such variation as was shown in the case of non-pool cars is expected.

Truck Production by Capacities

(U. S. and Canada)

	FIRST TWO MONTHS		
	Units		Per Cent of Total
	1942	1941	1942
1½ Tons and less	155,154	177,846	75.31
2 to 3 Tons	38,743	19,142	18.80
3½ Tons and over	6,373	4,186	3.09
Special and buses	2,722	841	1.32
Station Wagons	3,039	3,007	1.48
Total	206,031	205,022	100.00

PUBLICATIONS

A bulletin on **Compo-Oil Retaining Bearings** has been issued by Bound Brook Oil-Less Bearing Co., showing the methods of installation with diagrammatic drawings and details of burnishing and boring tools; essential information on eliminating reaming and machinery.*

The Magnus Chemical Co. has issued a new 50-page, illustrated handbook **Metal Cleaning in War Time.** It discusses in detail the metal cleaning problems in the production of shells, shell cases, fuses, other munitions and other parts and objects involved in the production of material and equipment important to the War Program.*

A new 8-page illustrated bulletin, describing **high pressure, motor driven, horizontal pumps** and **two-plunger steam pumps** has been issued by the Watson-Stillman Co.*

Prepare for after war now, urges Invention, Inc., of Washington, D. C., in a new booklet entitled **How to Have Your Own Patent Research Department in Washington.***

Wittek Mfg. Co.'s new condensed catalog

(*Turn to page* 57, *please*)

British Combine

Even the Volkswagen's in the Army!

According to recent reports, the Germans are using the famous "Volkswagen" in operations in Africa and along the Russian front where they have been used as anti-aircraft mountings, reconnaissance cars, and as substitutes for motorcycles. Recently, the British captured some of these vehicles which seem to have undergone a face-lifting preparatory to their adoption as military machines.

Individual Material Applications Halted

As a further step toward putting American industry under the Production Requirements Plan, J. S. Knowlson, director of Industry Operations, has announced that the War Production Board will soon discontinue granting preference ratings on individual applications for material to be used in general manufacturing operations.

Effective since April 21, no individual application from a manufacturer for materials to be incorporated in his products over a period of more than one month will be approved.

40 YEARS AGO

The fight between horizontal and vertical motors is still bitter, but we believe eventually the former will win, although it may not be an easy victory.

For all medium and light weight vehicles the single cylinder motor is certainly gaining ground. We believe it will gain still faster when its greater economy is better understood . . .

We wonder if forced circulation of the cooling water has not seen its best day, that is for vehicles of under 12 horse power? Likely it has . . .

The thing that pleased us most in the home cars was that they looked like *autos*, with a few levers, a little polished brass, a lantern or two, and perhaps one or two lubricators added, as *necessary*, to operate the machine. The French machine impresses one like an engineer's showcase containing pretty lanterns, a few horns, numerous beautiful oil and grease cups and a multitude of handsome levers, handles, tanks, etc., with an auto tacked on behind to push the showcase around.

From *The Horseless Age*, April 30, 1902.

Ration Boards Approve 72% of Car Applications

Approximately 41,000 new passenger automobiles had been released by local rationing boards throughout the country by the end of March, figures compiled by the Office of Price Administration indicate. In the 33 states for which figures are available, the rationing boards acted favorably on 72 per cent of the applications received. There were 14,579 applications, with 9212 quota certificates and 1284 non-quota certificates issued. The total quota allotment of new passenger cars for all states during March, April and May was 120,000.

Nickel from Cuba

Cuba is destined to become a new source of badly needed nickel. This was indicated recently by Materials Director Batt, of the WPB, who revealed that large deposits of the ore blanket the wooded plateaus of Cuba. The deposits will be extracted by a complicated chemical process. Experimental operations have been carried on by Nicaro Nickel Co., subsidiary of Freeport Sulphur Co.

Udylite Moves

The Udylite Corp., purveyor of electroplating and polishing supplies, has announced the removal of its Eastern District offices and warehouses from 60 East 42nd Street, New York City, to 11-16 Forty-Fourth Drive, Long Island City.

BOOKS . . . .

HANDBOOK OF CHEMISTRY AND PHYSICS, *25th Edition, published by Chemical Rubber Publishing Co., Cleveland, Ohio.*

This authoritative handbook, divided into five parts, contains mathematical tables, properties and physical constants of the elements and many compounds, general chemical tables, information on heat, sound, electricity, magnetism, and light, and conversion tables. Revised annually to keep pace with research work, the handbook includes for the first time an important section dealing with the properties of amino acids. Additional conversion tables, a section giving symbols and abbreviations, and a table of natural secants and cosecants are also included in this edition.

BULLETIN NO. 27, THE BUCKLING OF COMPRESSED BARS BY TORSION AND FLEXURE, *and* BULLETIN NO. 28, FLEXURAL-TORSIONAL BUCKLING OF BARS OF OPEN SECTION, *by Dr. J. N. Goodier, Professor of Mechanics of Engineering at Cornell University. Published by Cornell University Engineering Experiment Station.*

The use of thin-walled metal construction in aircraft has brought with it a number of special structural problems which have to be studied both experimentally and mathematically. These bulletins present a mathematical analysis of certain peculiar types of buckling which are encountered in tests of aircraft components, and may form a basis for design rules which will provide against such buckling.

AIRCRAFT HANDBOOK, *by Fred H. Colvin. Published by McGraw-Hill Book Co., New York, N. Y.*

A comprehensive manual for those concerned with aircraft maintenance and others who need a detailed working knowledge of airplane engines and accessories. The handbook covers all types of engines and their accessories, adjustable propellers, the most used airplane instruments, landing gear and floats, etc. It contains many understandable descriptions, tables, diagrams, and servicing and trouble shooting procedures.

ADVERTISING

Darrell C. Roberts, formerly assistant advertising manager Chrysler Sales Corporation and recently advertising manager Willys-Overland, Inc., has joined the Willard G. Myers Advertising Agency, Philadelphia.

N. W. Hopkins, formerly with Campbell-Ewald Co. on the Chevrolet account, has joined the staff of Radio Station WJBK at Detroit as co-ordinator of news broadcasts.

Sayre M. Ramsdell Associates, Inc., has been formed with **Sayre M. Ramsdell** of Philadelphia, who has been in charge of advertising and sales promotion for Philco, as president, **Frank A. Hutchins,** vice-president of Hutchins Advertising Co., Inc., as vice-president, and **Sidney J. Stall,** formerly of the Advertising Department of Philco, as secretary and in charge of production.

Roy Carl Hicks

Roy Carl Hicks, long a member of the automobile industry, died late last month in Detroit. He was associated with Dodge Brothers from 1914 to 1927, and with Graham-Paige Motors Corp. as secretary-treasurer from 1932 to 1940. Until his illness recently he was treasurer of the American Propeller Co., Toledo.

WHEN PROMPT DELIVERY COUNTS SO MUCH

NOW, when your products are so urgently needed, you can profit by the ready availability of the Torrington Needle Bearing. As a result of Torrington's expansion program, Needle Bearings in standard sizes and types can be *promptly delivered on all priority orders!*

You can benefit, too, by the Needle Bearing's other features—features that simplify your designs and speed your production processes. Consider these advantages of the Needle Bearing—and see how *every* one of them fills a wartime need.

IT IS EASY TO INSTALL. Built as a single compact unit, the bearing is simply pressed into place in the housing—a quick operation ideally suited to high-speed production line methods.

IT CONSERVES OTHER MATERIALS on which you may be encountering delivery problems. Because of the Needle Bearing's small outside diameter, you can reduce the size of your housings, and hence the amount of material required.

IT ELIMINATES EXTRA PARTS AND ASSEMBLY STEPS. No retaining rings, washers, or end plates are needed to hold the bearing in place—and in most applications, no special lubricating equipment need be provided.

AND IN PRODUCT PERFORMANCE, the Needle Bearing offers the advantages of long life, high load capacity, low power consumption, minimum need of service attention.

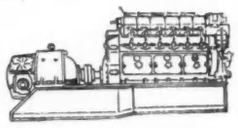
Let a Torrington engineer show you how these features—demonstrated in thousands of peacetime applications—can be incorporated in your wartime designs. For further details, write, wire, or phone for Catalog No. 107.

THE TORRINGTON COMPANY
Established 1866
TORRINGTON, CONN., U. S. A.
Makers of Needle and Ball Bearings
New York Boston Philadelphia Detroit Cleveland Seattle
Chicago Los Angeles San Francisco Toronto London, England

LET'S GO! U.S.A. KEEP 'EM FLYING

TORRINGTON NEEDLE BEARING

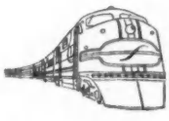
LONG SERVICE LIFE



High load capacity and efficient lubrication of the Torrington Needle Bearing result in long service life on the valve rocker arms of Model 36 Diesels built by Fairbanks, Morse & Co. Bearings reduce the need of replacements and of other service attention.

FAIRBANKS, MORSE

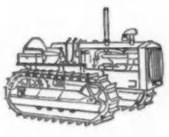
HIGH EFFICIENCY



Efficiency and dependability of operation are essential in railroad auxiliary equipment. Safety Car Heating & Lighting Co., Inc., obtains these advantages by using Torrington Needle Bearings on automatic control valves of its Carrier-Safety air conditioning systems.

SAFETY CAR

EFFECTIVE LUBRICATION



Because the Needle Bearing's outer race forms a reservoir holding ample quantities of lubricant, the need for service attention is reduced to a minimum. Caterpillar Tractor Co. profits by this feature in its famous line of "Caterpillar" Diesel Tractors.

CATERPILLAR TRACTOR

MEN

(*Continued from page 47*)

Paul Litchfield, board chairman of Goodyear Tire & Rubber Co.

Matthew J. Hickey, Jr., of Chicago, has been appointed board chairman of Luscombe Airplane Corp., Trenton, N. J., by Leo T. Crowley, alien property custodian for the Federal Government. **J. H. Torrens,** former president, will be retained as vice-president, and **Lee N. Brutis,** executive vice-president and general manager of Waco Aircraft Corp., has been named president and general manager. **L. H. P. Klotz,** holder of 67 per cent of the stock, has been removed as vice-president and Crowley has assumed trusteeship of his holdings.

Frank E. Hiter, vice-president in charge of sales, has been elected to the board of directors of Stewart-Warner Corp., succeeding Thomas P. Sullivan.

James K. Fulks has been elected vice-president in charge of manufacturing for Ex-Cell-O Corp.

Graham B. Trainer, formerly representative of the Chrysler Corp. in India, has been assigned to duty with the Storage and Issue Branch of the Motor Transport Division, U. S. Army, with headquarters in Washington.

Harry J. Klingler, general manager of the Pontiac Motor Division of General Motors, has been named mayor of the city of Bloomfield Hills, Mich., by the city commission.

Arthur C. Butler, manager of the motor truck division of the AMA for the last 10 years, has been appointed head of the Military Vehicles Division of the Automotive Council for War Production, with headquarters in Washington. **Walton Schmidt** has joined the staff of the ACWP as assistant manager of the Military Vehicles Division, located in Detroit. **James G. Ellis,** former Washington news editor for AUTOMOTIVE & AVIATION INDUSTRIES, will assist Butler in his Washington activities.

R. H. Isaacs, sales manager of the Pioneer Instrument Division of Bendix Aviation Corp.; **W. P. Loudon,** of Electric Auto-Lite Co., and **Victor Carbonara,** vice-president of Kollsman Instrument Division of Square D Co., have been appointed members of the nine-man Combat Instruments Industry Advisory Committee of the War Production Board.

Leslie E. Hess, formerly executive vice-president, has been elected president of the J. G. Brill Co., succeeding **Charles J. Hardy,** who becomes chairman of the board.

Walter O. Briggs, Jr., son of the founder and board chairman, has been elected treasurer of the Briggs Mfg. Co., succeeding Robert Pierce, resigned. **A. D. Blackwood** has been elected secretary, succeeding the late H. W. Griffith.

Warren H. Clarke, formerly Michigan director of the Contract Distribution Branch of the War Production Board, has been appointed assistant general manager of the Houde Engineering Division of Houdaille-Hershey Corp.

N. K. Van Derzee, formerly eastern sales manager for Hudson Motor Car Co., has been named head of the new war contract division, which will maintain liaison between Hudson's former automotive divisions and the Government on war work.

G. A. Vandervell, managing director of Vandervell Products, Ltd., of Great Britain, has been elected a director of Cleveland Graphite Bronze Co.

William E. Boeing, founder of Boeing Aircraft Co., has returned to the company in an advisory and consulting capacity. He retired from the chairmanship in 1934. **Perry V. Ogden** has been appointed factory manager and general superintendent.

Sidney L. Miller, formerly executive head of the Bureau of Business Research at the University of Iowa, has been named assistant chief of the Transportation Branch of the War Production Board. **Edward S. Pardoe,** formerly executive assistant of the Capital Transit Co., Washington, has been appointed chief of the bus, electric railway and other transportation equipment section of the Transportation Branch.

A. L. Boegehold, chief metallurgist for General Motors Corp., has been awarded the J. H. Whiting Gold Medal by the American Foundrymen's Association.

Glen A. Bassett, formerly vice-president and treasurer, has been elected president of Gar Wood Industries, Inc., succeeding **Garfield A. Wood,** who has been elevated to the chairmanship of the board. **Edward Boehm,** formerly vice-president, has been named treasurer. Four new directors elected to the board are **Ralph S. Jenkins,** vice-president and general manager; **Francis A. Callery,** vice-president in charge of finance for Consolidated Aircraft Corp.; **Carroll E. Gray,** president of Burr & Co., Inc., and **A. W. Herrington,** president of Marmon-Herrington, Inc.

Cleveland E. Dodge, vice-president of Phelps Dodge Corp., has been elected a director of B. F. Goodrich Co., succeeding **Arthur B. Newhall,** who resigned when he became co-ordinator of rubber for the War Production Board.

Harold I. Crow, formerly vice-president of Air Associates, Inc., has been named president, succeeding **Fredric G. Coburn,** who resigned. Coburn took over the presidency last November after the U. S. Army assumed operation of the plant for a 60-day period following a labor dispute. **Harry A. Oswald,** factory manager, also has resigned.

Ronald S. Gall, formerly public relations manager for Brewster Aeronautical Corp., has been named head of the New York office of the Aeronautical Chamber of Commerce.

If you produce
SHELL PARTS...
THESE PROVEN products developed by KERNS chemists are helping to establish top production rates on the following shell operations:
FOR SHELL FORGINGS
KERNS HOT DIE COMPOUND—Reduces Sticking and Scoring
FOR SHELL AND FUSE MACHINING
KERNS CUTTING COMPOUNDS—For Ferrous and Non-Ferrous Metals
FOR SHELL CASES
KERNS DRAWING COMPOUNDS—Reduce Rejections and Increase Die Life
FOR ALUMINUM DRAWING
KERNS ALUMINUM DRAWING COMPOUND — Eliminates Discoloration—Reduces Rejections
Let us send you a complete set of TECHNICAL DATA SHEETS detailing the application of above products.
We are eager to demonstrate a Kerns Compound on your toughest job. Write or phone for a production test sample. No obligation.
L. R. KERNS COMPANY
2657 EAST 95th STREET • CHICAGO, ILL.
A. J. LYNCH & CO. • 2424 Enterprise St. • LOS ANGELES, CALIF.
L. R. KERNS COMPANY • 1609 Investment Bldg. • PITTSBURGH, PENN.

strove for safety

and achieved simplicity

THE underhammer rifle that Kendall first designed has long been superseded by faster, more accurate, more powerful weapons. The mechanical principles by which Nicainor Kendall worked have long been the common property of progressive engineers.

But leadership in the application of those principles did not die with Nicainor Kendall. Nor did it die with men like Robbins, Howe, Hilliard and Hartness, whose successors are responsible for the most recent advances in Jones & Lamson machine tool technique.

As a result of these advances, modern Jones & Lamson machine tools, optical comparators and threading tools embody numerous unique advantages.

In Jones & Lamson machine tools, these advantages are apparent, not only in refinement and ease of operation, but in ample reserves of speed, rigidity and useful power, enabling you to make the fullest possible use of each new development of hard alloy cutting tools. Thus you can speed wartime production and be prepared to meet the keen competition of a postwar world.

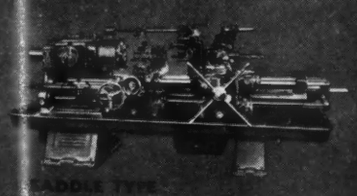
Write today to Jones & Lamson engineers regarding your production problems. Inquiries from large plants or small receive prompt and thorough study here.

LAMSON MACHINE COMPANY

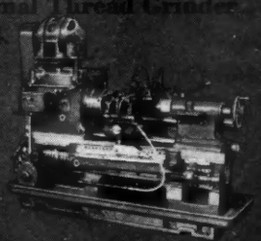
SPRINGFIELD, VT., U. S. A.

Jones & Lamson Automatic Internal Thread Grinder
Model TG-624

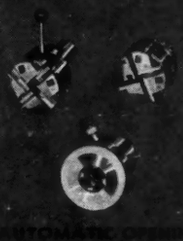
Manufacturers of Ram & Saddle Type Universal Turret Lathes . . . Fay Automatic Lathes . . . Automatic Thread Grinding Machines . . . Comparators . . . Automatic Opening Threading Dies and Chasers



SADDLE TYPE UNIVERSAL TURRET LATHE



FAY AUTOMATIC LATHES



AUTOMATIC OPENING DIE HEADS

PROFIT PRODUCING MACHINE TOOLS

Outdoor Bus Terminal

To avoid air raid risks presented to large concentrations of busses housed in garages, the British have built many "dispersal points" near Manchester. In the picture, lines carrying low-pressure steam generated by a gas-fired boiler are shown attached to each radiator. Thus the water is kept at about 130 F and the need for antifreeze solutions is obviated. In other locations, steam is produced by two vertical boilers installed in a small boiler house; another alternative is offered by individual electrical immersion heaters for each radiator.

Add Members to SAE War Engineering Board

Six new members have been added to the War Engineering Board of the SAE, according to James C. Zeder, chairman of the board and chief engineer of Chrysler Corp. The new members are L. R. Buckendale, vice president and chief engineer of Timken-Detroit Axle Co.; Arthur Nutt, vice president in charge of engineering of Wright Aeronautical Corp.; Don Berlin, aircraft engineer for General Motors Corp.; C. G. A. Rosen, director of research for Caterpillar Tractor Co.; Ralph R. Teetor, vice president of Perfect Circle Co.; and Earl H. Smith, executive engineer of the aircraft engine division, Packard Motor Car Co.

Forms New Company

Robert G. N. Evans, recently associated with the Curtiss Development & Manufacturing Co., announces that he has formed a new organization, the Evans Engineering Co., Milwaukee, Wis., of which he is the president. This company will be active in the manufacture of sleeve bearings, including the addition of larger bearing sizes.

Canadian Ford Losses

Ford Motor Co. of Canada, Ltd., suffered a loss of $418,847 in shares held in the Ford Motor Co. of Malaya, Ltd., when the assembly plant and other property in Singapore fell to the Japanese, Feb. 15. The loss has been charged to the general reserve account, according to the annual report.

Plan Research Center

Detroit Rubber and Plastics Group, Inc., Detroit, Mich., an organization of technicians interested in the promotion of scientific progress in the field of rubber and plastics technology has announced the establishment of a center for study and research in this field at Wayne University.

Formal acceptance of this proposal was made by the University and the Detroit Board of Education. Following this, arrangements were effected for the allocation of space in the special problems laboratory of chemical engineering to house equipment to be provided by private donations. Courses in this department which are expected to be available by Sept. 1, 1942, include (1) an introductory course covering the properties and testing of rubber and plastics; (2) courses in compounding, molding, and testing; and (3) research projects in both fields.

Packard Awarded Navy "E"

Packard Motor Car Co. has been awarded the Navy "E" for excellence in the production of marine engines that power the boats of the patrol torpedo fleet. The presentation will be made May 5 at ceremonies at the plant in Detroit.

John F. Taylor

John F. Taylor, 59, a research engineer with General Motors Corp., died April 14 at his home in Detroit. He was a member of the SAE.

Auto Unions Push Victory Programs

(*Continued from page 43*)

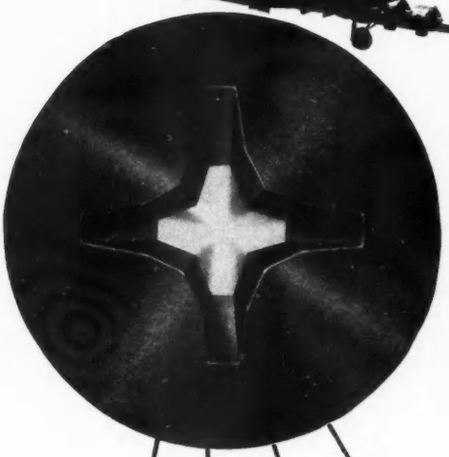
recently when the Ford Motor Co. added $90 apiece to the price of 9384 special sedans ordered by the Army. In order to complete the order before passenger car production lines were converted to war work, Ford operated on a Saturday and Sunday late in January to complete the job. This increased the cost by $844,560, the original contract price of $680 apiece being raised to $770 due to the higher wage costs.

With the General Motors contract with the UAW-CIO due to expire April 28, early action of the War Labor Board upon this issue was anticipated. Negotiations at Detroit have been stalled upon the questions of the union shop and the $1-per-day raise demands of the union. Last year the negotiations went beyond the contract expiration date, with the revisions being agreed to on May 13 after the National Defense Mediation Board recommended a 10-cent-per-hour wage increase retroactive to April 28. After three years' effort, the UAW-CIO finally won an NLRB election at the Harrison Radiator Division in Lockport, N. Y. The UAW-CIO received 2175 votes to 634 for no union. Employes had voted against any union in 1940 and 1941.

The War Labor Board recently recommended a 4½-cent-per-hour wage increase for 25,000 workers in eight plants of the International Harvester Co. The union had asked for 12½ cents. The pay question may be reopened July 15. Raises are retroactive to Jan. 15. By an 8 to 4 decision in which the four management members of the board dissented, a maintenance of union membership clause was approved in place of the union shop, providing that the employes in a secret referendum in each plant vote for the clause. The FEWOC (CIO) and two AFL federal unions were involved in the case. Union members will be required to maintain their membership and dues for the duration of the contract. The unions in urging the closed shop had agreed to have the minority in each plant join the majority after the holding of plant elections. Plants involved are the Tractor, West Pullman, and McCormick Works at Chicago, and plants at Springfield, Ohio; Rock Island, East Moline, and Rock Falls, Ill., and Milwaukee.

Correction

The Stirling bomber's maximum bomb capacity as stated in the April 15 issue of AUTOMOTIVE AND AVIATION INDUSTRIES is not "between 6000 and 8000 lb.," but "up to 8 tons." The original statement was based on misinformation; the second is supported by data released by the British.



THE LAST TURN – Make? . . or Break?

A big advantage of the Phillips recessed head screw principle is the greater tightening power afforded by the increased contact between driver and recess . . . *provided* that the two components are strong enough to resist breaking.

Phillips Recessed Head Screw Matches Turning Power with Strength

Before the Phillips Recessed Head ever appeared on the market, hundreds of tests had been made to determine exactly the shape, depth and taper of recess which would give increased turning efficiency without danger of splitting the screw head or breaking the bit. Actual performance on many aviation and automotive assembly lines has since confirmed our engineers' conclusions.

Now, over 200 fastening experts, headed up by the 19 manufacturers of Phillips Screws, are in the field to help you with your fastening problems and to suggest ways of further increasing the savings in time and dollars through the use of Phillips Recessed Head Products.

In the average case, Phillips Screws cost 50% less to use. That's why the majority of leading aviation and automotive manufacturers use Phillips.

Remember—it's not the price of the screws that counts . . . it's the cost of using them!

Speed Product Deliveries by Saving Assembly Time

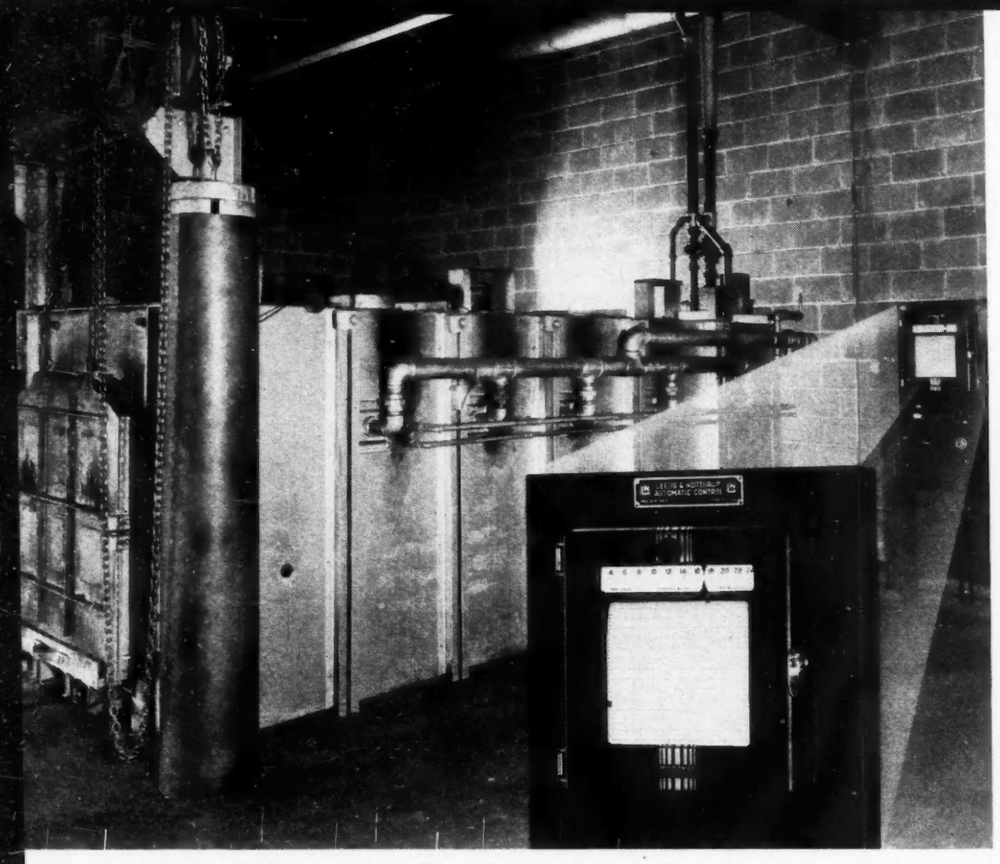
Specify Phillips and Save 50%

PHILLIPS RECESSED HEAD SCREWS

WOOD SCREWS • MACHINE SCREWS • SHEET METAL SCREWS • STOVE BOLTS
SPECIAL THREAD-CUTTING SCREWS • SCREWS WITH LOCK WASHERS

19 SOURCES OF SUPPLY

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N.H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N.Y.
Pawtucket Screw Co., Pawtucket, R.I.
Pheoll Manufacturing Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N.Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N.H.



Because of the kind of work it's doing right now, no photograph may be taken of the furnace referred to below, but this picture shows a unit of comparable gas consumption.

100,000 Ft of Gas Per Month Saved for War Use by Micromax

When a new industrial furnace was being installed in a certain plant, the orders failed for some reason to include a control pyrometer. The furnace was badly needed, however, so it was fired up under manual control, while its Micromax Controller was being rushed to the job. The before-and-after results of Micromax Control were most interesting.

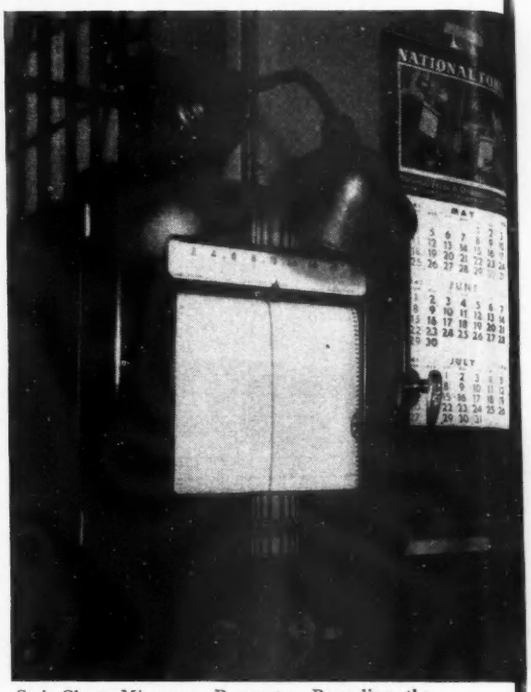
The first result, when Micromax was installed, was a cheer from the foreman, because he was tired of tending the furnace by hand. Next, management cheered, because the furnace's gas bill dropped $50 per month. And finally the gas company joined in, because the saving gave them 100,000 feet more fuel per month, urgently needed by other war plants. This 100,000 feet was ten per cent of the furnace's fuel.

The Micromax qualities which made possible maximum savings in this case are available to every user, and are often as valuable on old furnaces as on new ones. For Micromax Controllers can be quickly applied to any furnace. Thousands are doing fine jobs by simply opening a by-pass valve wide when temperature drops and closing it tight when temperature rises again. Other thousands use a control in which the valve moves *in proportion* whenever there's a temperature change. This is control at its best. It automatically does the right thing even when someone opens the furnace door; when the fuel pressure changes; when the furnace is loaded to capacity as well as when it's almost empty.

If you have a war-time job of temperature control, one of our engineers will be glad to talk it over with you, on request. Or perhaps you'd rather just have our Folder N-00A(1), which describes the Controller.

Correct Anneal of Guns Is Shown By Micromax In Big Ordnance Plant

Makers of big guns, periscope tubes, giant crankshafts and similar heavy forgings for the Army and Navy are generally required to prove, by pyrometer charts, that the annealing has been done as specified in orders. Many of these forgings makers rely on Micromax Pyrometers for this exacting duty; we show here some typical applications.



Strip-Chart Micromax Pyrometer Recording the anneal of a big gun barrel.

The strip-chart Micromax is one of a battery, located in a temperature-control room. The door is locked against all except inspectors, and the pyrometers thus give impartial reports of the annealing of "fighting" forgings.

Round-Chart Micromax guiding furnace operator.

The round-chart Micromax pyrometers are mounted right alongside the big annealing furnaces, to guide the operators in holding the temperatures reported by the strip-chart machines. Their big dials and bold arrows enable the men to see from a distance, without hovering continuously over them.

In addition to these two Micromax models shown, there are 3 others available in hundreds of ranges. One or another will handle any temperature problem of any industrial furnace. They are described in Catalog N-33A, sent on request.

Jrl Ad ENT-0600C(46)

LEEDS & NORTHRUP COMPANY, 4966 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Conversion

(*Continued from page* 29)

motive Council for War Production, George Romney, managing director, announced that two-thirds of the machines listed are working or about to work on war materials, while one-fifth of the total machines is immediately available for war work or for transfer to other manufacturers. Two hundred and seventeen automotive companies have listed the equipment of 350 plants, in addition to 85 companies which have their entire facilities engaged in war production. Of the first 102,000 machines for which records have been compiled by the ACWP, 65,000 units, or 64 per cent, are now operating on war work. Equipment listed as immediately available for sale or lease to other manufacturers numbers 14,000 machines, or 12 per cent.

About 10,000 machines, or 9 per cent, are working on replacement parts. A total of 1500 machines have been allocated for use on war contracts in the near future, while 1000 units are earmarked for pending contracts. Immediate war work is being sought for 9000 machines. Greatest demand is for automatic screw machines, while the greatest supply is of metal pressing and stamping equipment for which there is little war use.

Plans are advancing for the Chrysler aircraft engine plant. This plant will employ more than 25,000 men. Construction work is due to start shortly and it is expected that production will be under way by the end of the year.

Automotive plants are contributing their share to the mounting monthly totals of plane production, which reached 3300 planes in March, according to Rep. Sam Rayburn, Speaker of the House, in a speech at Sulphur Springs, Tex. They also will furnish airframe parts and engines for a new Texas assembly plant for B-24 bombers from which the first bomber came off the assembly line in mid-April 110 days ahead of schedule. This plant is being operated by Consolidated Aircraft Corp. and is one of four bomber assembly plants in the central U. S. Another plant already is turning out B-25 bombers with parts fabricated by Fisher Body.

Publications

(*Continued from page* 47)

describes the Wittek **Type FB Hose Clamp** for aircraft use. It contains specifications, illustrations and descriptions on this and other types of Wittek hose clamps especially adaptable to the aircraft industry.*

Bulletin No. 103, Lord Mfg. Co., covers its **vertical (V.S.) type mountings,** as related to vibration and shock control.*

The current issue of INCO, magazine of International Nickel Company, contains articles on the **salvage of scrap, sub-contracts** and the **conversion of supplies.** Included also is an article on the part which **nickel and nickel alloys** play in the production of essential wartime material, including tungsten and plastics used in the construction of military and naval airplanes.*

Vickers Power Brake Co.'s new circular gives information regarding its new **hydraulic booster.** It illustrates the booster and describes its method of operation.*

A new booklet by Jessop Steel Co. describes **Washington Carbon Tool Steel,** a straight carbon tool steel which is widely used for tools and die application.*

Plexiglas Methods of Installation, a new booklet by Rohm & Haas Co., gives the basic principles behind **Plexiglas** installations. Written chiefly for designers and engineers, the booklet contains a section on installations, one on channel and clamp mountings and a third on nut and bolt and rivet mountings.*

The first issue of the **Sellers Diamond,** published by William Sellers & Co., contains an article on the Sellers Power Flow Planer in use at the Chrysler Tank Arsenal.*

Clark Tructractor division of Clark Equipment Co. has issued a booklet, **Unit Packaging,** describing their method of packaging for use in automotive plants.*

Handy & Harman has issued a new bulletin on tool brazing and repair.*

Looking In on Honest Weight is the title of a new 16-page brochure published by the Toledo Scale Co. It provides a pictorial survey of the human and mechanical resources back of the making of the modern precision scale. Also included is a graph which traces the development of weighing devices from 5000 BC to the present.*

* Obtainable through editorial department. AUTOMOTIVE *and* AVIATION INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia. Please give date of issue in which literature was listed.

ONLY LAPPING *As Strom Does It* CAN PRODUCE SUCH PRECISION

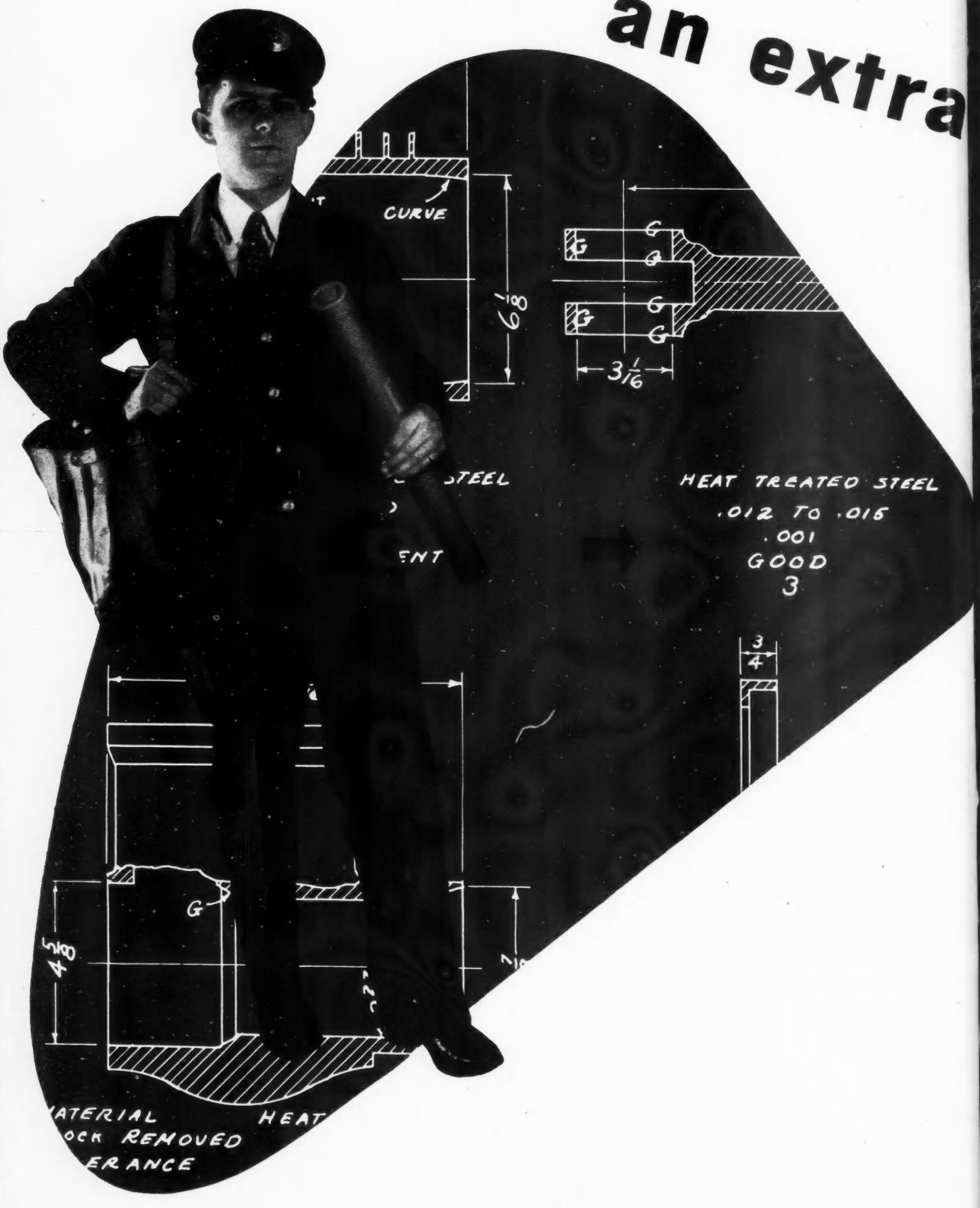
Strom Steel Balls possess a degree of surface smoothness and sphericity that has never been equalled in any other regular grade of ball. Such precision is exclusive with Strom because it can be attained only through a series of lapping operations such as are standard practice in the Strom plant.

Physical soundness, correct hardness, size accuracy and sphericity are guaranteed in all Strom Balls.

Other types of balls—*stainless steel, monel, brass* and *bronze,* are also available in all standard sizes. Write for complete details.

Strom STEEL BALL CO.
1850 So. 54th Avenue, Cicero, Ill.
The largest independent and exclusive Metal Ball Manufacturer

an extra


CURVE
6 1/8
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HEAT TREATED STEEL
.012 TO .016
.001
GOOD
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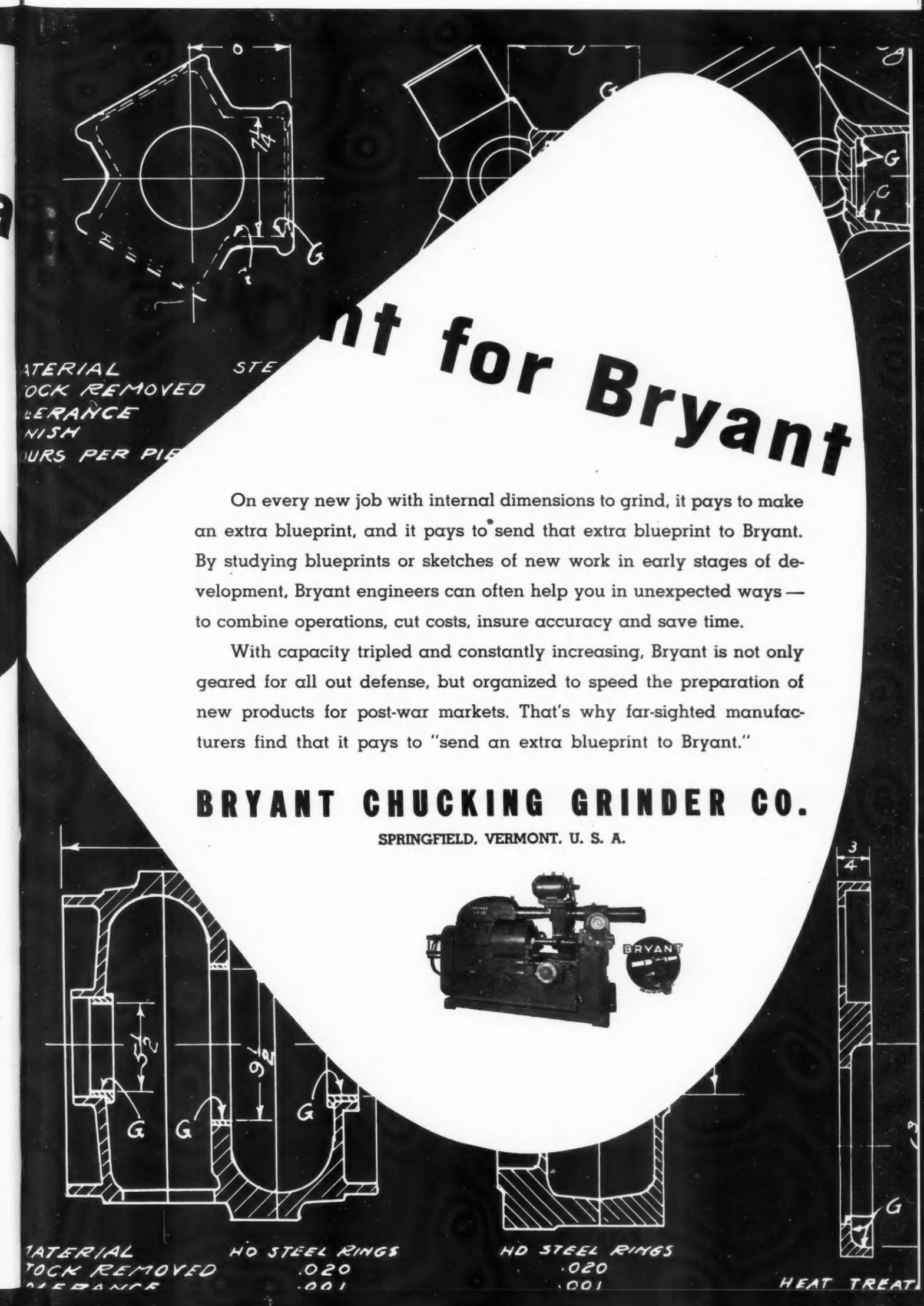
ATERIAL
OCK REMOVED
ERANCE
NISH
URS PER PIE
STE
nt for Bryant
On every new job with internal dimensions to grind, it pays to make an extra blueprint, and it pays to send that extra blueprint to Bryant. By studying blueprints or sketches of new work in early stages of development, Bryant engineers can often help you in unexpected ways — to combine operations, cut costs, insure accuracy and save time.
With capacity tripled and constantly increasing, Bryant is not only geared for all out defense, but organized to speed the preparation of new products for post-war markets. That's why far-sighted manufacturers find that it pays to "send an extra blueprint to Bryant."
BRYANT CHUCKING GRINDER CO.
SPRINGFIELD, VERMONT, U. S. A.
BRYANT
HD STEEL RINGS
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HD STEEL RINGS
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HEAT TREAT

Production Shortcut

Operated by a mere handful of men, the rotary table designed and fitted by Lockheed engineers to this 250-ton single - action hydraulic press is said to afford a production of 20,000 small stampings every eight hours. Each "feeder" places one or more small blanks on the table as it wheels past him. After forming in the press, the parts are removed by workers shown in the background.

CENSORED

An exclusive feature prepared by the London correspondent of AUTOMOTIVE AND AVIATION INDUSTRIES, M. W. Bourdon.

Non-essential use of private passenger cars is to cease on June 30, for after that date no basic ration of gasoline will be issued; as a preliminary it will be halved in May and June. The object is to put a stop to all recreational motoring, though it is admitted that this will not effect much economy in gasoline, owing to the great majority of cars licensed during the war being required for essential personal transport, for which "supplementary" rations have been and will continue to be granted. Rationing for cars is thus brought into line with that now applied to trucks, the basic ration of which was recently discontinued.

* * *

The Government has turned down a proposal that in the interests of fuel economy a speed limit of 25 m.p.h. for trucks and buses and one of 35 m.p.h. for cars should be enforced. The Government spokesman said that any fuel saving that might result would be offset by the slowing-down of vital traffic concerned with the war effort.

* * *

The Ministry of Supply has launched an intensive campaign to accelerate and extend the reconditioning of worn parts of all mechanical appliances. Automobile manufacturers are cooperating by giving detailed advice to repairers to the best methods to adopt in the treatment of various parts.

* * *

Manufacturers of air compressors are urging service and filling stations to discard the "free air" policy and to agree upon a uniform national charge to be made to all-comers for tire inflation. With the revenue from gasoline sales so greatly reduced owing to rationing, plus the shortage of labor and increased overhead charges and taxation, now is the time, it is contended, to stop once and for all giving away service which no motorist can reasonably expect to obtain for nothing.

The London showrooms of the Ford Motor Co. have been placed at the disposal of the Ministry of Supply and the Waste Paper Recovery Association for an exhibition showing provincial firms and organizations what can be done with success when an all-out salvage campaign is organized, and how waste paper is converted into munitions of war. Over 3000 people a day on the average have visited the exhibition since it was opened in February.

* * *

Owing to increasing shortage of labor, municipal bus undertakings outside the London area are investigating the possibility of pooling their maintenance and repair facilities on a regional basis. They have been advised officially to economize in skilled labor by "breaking-down" each compound operation into a number of relatively simple jobs to be undertaken by semi-skilled men or women, to upgrade maintenance labor to the utmost, to make more use of drivers in maintenance work, and to obtain boys fresh from school and train them.

* * *

Besides the enforced pooling of their trucks and delivery vans to save fuel and tires, local retailers are being prohibited from delivering goods beyond a radius of one mile from their premises and from making more than one delivery to any customer each week, except in the case of newspapers and perishable articles of food such as milk and bread.

* * *

The Minister of War Transport has taken powers to requisition any stock of replacement parts, components, tools, tires, accessories and equipment where he has evidence that overstocking or hoarding is taking place in the case of firms or individuals who sell or use such items in connection with business.

NIAA Offers New Service

With the rapid shifting during wartime of personnel among industrial advertisers, agencies, and publishers, the National Industrial Advertisers Assoc. has set up a new employment service designed to help qualified advertising men to make contact with prospective employers. The chairmen of the NIAA Employment Service as as follows:

The eastern district, headed by H. M. Ellsworth of the Eastern Industrial Advertisers Association, c/o Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Penna.. will comprise the following NIAA Chapters:

Boston—G. E. Pomroy, Factory Management & Maintenance; Cleveland—A. Broggini, National Carbon Co.; Maryland—A. M. Gladmon, Pittsburgh Plate Glass Co., Baltimore; Mason Dixon—G. Hecker, A. B. Farquhar Co., York, Pa.; Montreal — L. G. Morris, Swiss Elec. Co. of Canada, Ltd.; New Jersey—P. Wilcox, Keuffel & Esser Co., Hoboken; New York—E. Laing, Westinghouse Elec. & Mfg. Co.; Philadelphia—H. M. Ellsworth, Penna. Salt Mfg. Co.; Pittsburgh—E. Kennedy, Copperweld Steel Co., Glassport, Pa.; West New England—R. H. Young, R. H. Young & Assoc., Hartford, Conn.; Youngstown—R. P. Dodds, Truscon Steel Co., Youngstown, Ohio

The western district, headed by C. N. Kirchner of the Chicago Industrial Advertisers Asso.. c/o Independent Pneumatic Tool Co.. 600 W. Jackson Blvd., Chicago, Ill., will comprise the following NIAA Chapters:

Chicago—C. N. Kirchner. Independent Pneumatic Tool Co.; Cincinnati—R. G. Hext, Littleford Bros.; Detroit—L. S. Martz, Micromatic Hone Corp.; Indianapolis — S. Murray. Perfect Circle Co., Hagerstown, Ind.; Los Angeles—D. E. Browne, California Oil World; Milwaukee—A. Oberndorfer, Hevi Duty Electric Co.; Minnesota—Roy Smallwood, Wm. H. Ziegler Co.; Rockford—Paul Froeb, Ideal Commutator Dresser Co., Sycamore; San Francisco—Ernest Mathy, Victor Equipment Co.; St. Louis—G. Sears, McGraw-Hill Publishing Co., Inc.; Toledo—E. R. Youngs, Toledo Pipe Threading Machine Co.; Toronto—T. H. Dowsett, Trane Co., Ltd.

Treated Steels

(*Continued from page* 44)

is on. Although a considerable part of continuous rolling mill capacity has been diverted from the production of sheets and strip to that of plates, the demand for larger production of the latter continues insistent, and further conversion of strip and sheet mills into plate mills is talked of.

That price ceilings do not preclude the possibility of adjustments on a lower basis, when justified by costs, was borne out when thirteen manufacturers producing 95 per cent of the brass materials used in the making of small arms ammunition agreed to reduce the prices of their products 1 cent per pound.

Price Administrator Leon Henderson, who announced the downward revision, ascribed the reduction to the large volume of Government demand for cartridge case and bullet jacket metal. Substantial savings to the Treasury will result from the voluntary price reduction agreed to by the brass manufacturers.

Silver's Importance Grows

(*Continued from page* 19)

is made by this method, the ductility of silver facilitating production. Structures, almost as dense as if conventional alloying were possible are obtained. At present the chief application is in the making of electrical contact points as well as those on spark plugs and the coils of automobiles, but expansion of the utilization of sintered silver mixtures is said to be in the offing.

Being the best possible electrical conductor, silver could, of course, substitute for copper and aluminum in such uses as bus-bars, if the war's exigencies eliminated the employment of these two metals in all but the most important military and naval applications. The very fact that such substitution of silver for copper and aluminum has been seriously discussed, indicates that silver is being more and more thought of in terms of its usefulness rather than its value as coinage bullion.

A wide range of uses of silver in ordnance applications bears out the metal's growing scope in the filling of war needs. It is used in the making of certain shells. Silver brazing alloys are used in aerial bombs. Silver in various forms in anti-aircraft guns. There are numerous silver-brazed joints in an army field kitchen stove. Silver brazing alloys are used in the making of many other forms of munitions.

Mention may also be made of the use in the form of a nitrate of silver as the reflecting agent of automobile mirrors. An increasing volume of these now goes through an electroplating process combined with the conventional deposition of the metal and its protective coating. Nor should sight be lost of the use of silver in many types of reflectors, especially so since nickel and chromium are no longer available for other than strictly military and naval requirements.

With Mexico holding the lead among silver-producing countries, our neighboring republic having chalked up a record of more than 86,000,000 fine ounces in 1940, silver output of the Western Hemisphere exceeds 200,000,000 fine ounces a year, to which the United States contributed around 70,000,000 fine ounces last year. The other Continents are estimated to produce annually between 60,000,00 and 65,000,000 fine ounces. Much of our domestic silver production consists of the contribution made to the supply by mines other than those classed as silver mines. Copper, lead and zinc producers market important tonnages of silver, obtained by them as a by-product in their operations, but determining in not a few cases the profitability of their enterprises. Through the instrumentality of the American Silver Producers' Research Project, set up for investigating and developing the use of silver in the industries, efficient promotional machinery for broadening not only the market for silver but also for extending knowledge regarding its technical utilization has been provided. Consideration of the U. S. Treasury's silver holdings and purchases has been eliminated from discussion here because the subject belongs more properly so in the realm of political economy as does that of the probable effect of the war on India's status as the world's principal buyer of silver for its treasure value. Of chief significance is the impressive growth in the uses to which silver is being put industrially, especially so in the automotive and aviation fields.

Cadillac's Car Conservation Plan

The Cadillac Motor Car Division of General Motors is urging a six-point conservation plan for car owners. The plan suggests the use of a wheel lock, mileage inspection, maintenance financing, use of GM's credit cards, a lubrication schedule and timely overhauling.

NO MEASURABLE WEAR
Reported by
PROMINENT
MANUFACTURER
THEIR PROBLEM
To increase life of gears and anti-friction bearings in high speed precision tools.
THEIR SOLUTION
Addition of "Oildag" (colloidal graphite in oil) to regular greases.
THEIR RESULT
(a) Reduced temperature rise from 60°F to 45°F
(b) Current input 14% less
(c) No measurable wear on gears after 1500 hrs., nor on bearings after 300 hrs.
'Oildag' is a registered trade mark of A. C. C.
Ask for complete report of test and Bulletin No. 92 C
ACHESON COLLOIDS CORPORATION
PORT HURON, MICHIGAN
The electric furnace graphite in "dag" products is manufactured in the U. S. A.

Development of Supertanks

(*Continued from page 27*)

therefore, obvious that even thin armor provides a great degree of protection. Armor, unfortunately, is the greatest weight-producing factor in a tank and offers the greatest problems in machining and fabrication.

It is the present practice of the United States Army to use rolled face-hardened armor plate. This type of plate gives the greatest protection from small-caliber bullets up to caliber .50. However, it is not well suited to withstand the shock of larger-caliber projectiles. For lightly armored vehicles it is necessary to use face-hardened plate because this is the only type of thin plate which will keep out the bullets from high-powered machine guns.

Rolled homogeneous plate offers the best ballistic values against projectiles larger than machine-gun bullets. It furnishes protection against small-arms bullets which cannot penetrate so great a thickness and is also a superior type of plate for absorbing the shocks of heavier-caliber cannon projectiles. It can be welded and formed.

The use of cast armor in the United States is increasing. Up to the present time, cast armor has been made to give about 90 per cent of the ballistic value of rolled homogeneous plate. Cast armor has an important design advantage in that it can be contoured and sloped to any desired shape and thus achieve some advantage in ballistic values.

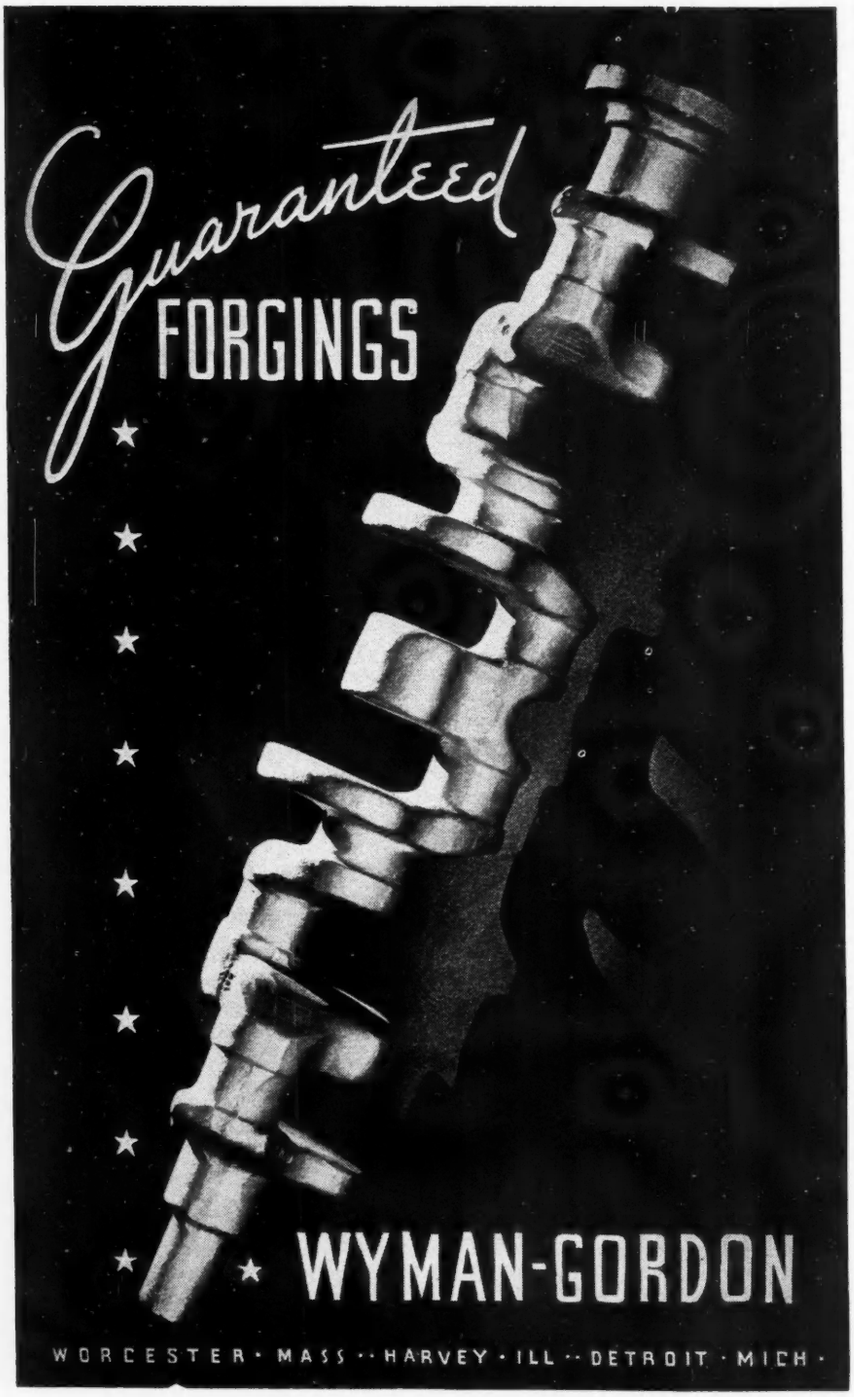
Tank plates may be riveted or welded together. While we completely welded a tank as early as 1933, and while we have made armor-plate castings at Watertown Arsenal over a long period of years, welding and casting have entered the field of design extensively only during the last year. The urge to weld or cast comes largely from the desire to eliminate riveted structures which are somewhat weak ballistically. The rapid development in welding armor during the past year insures that welding will be extensively used in tank manufacture in the future.

In regard to armor, it may be said that the trend of modern design is toward the use of thicker plates. Here the tank designer is confronted with a very difficult problem because, as the armor thickness is increased the weight of the vehicle is increased, requiring greater horsepower—until the law of diminishing returns in tank design is encountered.

Mobility is likewise one of the fundamental tank characteristics in that it determines the facility with which the guns of a tank can be brought to the point of desired employment. The mobility naturally depends upon the weight of the vehicle, the power of the engine employed, the width of track, the length of the vehicle, and the corresponding pounds - per - square - inch pressure between the track and the ground. By "mobility" we mean not only speed but also maneuverability under different conditions of speed and terrain. Mobility is of vital importance because it affords additional protection to the crew.

The safety of the tank personnel is dependent not only on the thickness and quality of the tank armor, but also upon the tank speed and the type of terrain over which employed. Thus, if a tank can move at a high rate of speed, it will present itself as a target to the enemy for a limited time. The length of time will determine the number of shots the enemy tank gunners can fire which will determine the number of hits which can be made. Since any armored vehicle is capable of absorbing a certain number of penetrations before it is put out of action, this time factor is of great importance. The desire of the tank designer, therefore, is always to secure the greatest possible speed over all types of terrain.

Foreign tank designers have not



Now is NO TIME to consider the WEATHER

Self preservation necessitates that the job at hand be considered immediately.

And now is no time for any industry to look far beyond the job at hand when the job is the preservation of the democracy which created and fostered that industry.

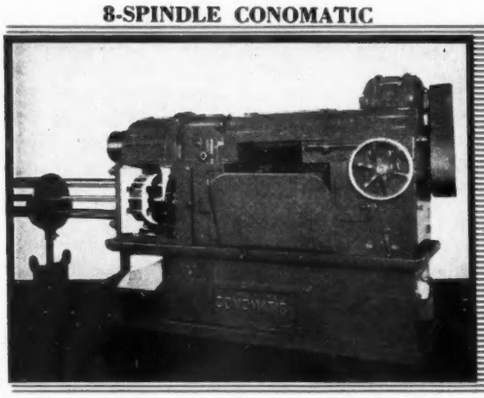
That is why we have priorities — that is why we believe in priorities.

Mass production, in which Cone has been a pioneer and leader, has been a prime factor in building up our American standard of living. That same mass production has now been called upon to protect it.

Cone is doing a 7-day week production job on defense work. Cone is on the job 100% to protect a standard which it helped create. Cone is building sturdy, accurate, volume-producing automatics as fast as possible without sacrifice to Cone standards. We all have a job to do NOW, and Cone is on the job to help do it.

We will be glad to send operator's handbooks and other information which will help speed defense production on all Conomatics now in the field.

8-SPINDLE CONOMATIC



CONE AUTOMATIC MACHINE COMPANY Inc.

WINDSOR, VERMONT, U.S.A.

given speed as high a value as we have. This probably has been due to the fact that only engines of relatively lower horsepower have been available. Regardless of the reason, it is a fact that most European tanks, including German, have about one-half the horsepower-to-weight ratio of the corresponding American vehicles. For this reason, it may be expected that American tanks will travel much faster than foreign vehicles and will be more difficult to put out of action.

The power train and the running gear give the tank mobility. The units must be light because the payload on this vehicle is crew, armor, guns, and ammunition. They must be readily accessible for quick adjustment, repair, or replacement, as these units have the greatest effect on mechanical reliability.

Prior to August, 1940, the Ordnance Department had not undertaken the design and manufacture of a heavy tank due to lack of funds; such a project would have consumed too large a proportion of the research moneys then available. In August, 1940, however, the Ordnance Department received its large appropriation from the Congress and was, therefore, able to afford the luxury of designing and manufacturing supertanks. It was in a position to undertake such a design since a large percentage of the tank components which had been under intensive development during the past 20 years by the Ordnance Department could be utilized in the construction of a large supertank by strengthening and enlarging these components as required for use with a large and heavy vehicle.

A number of difficult engineering problems have arisen in connection with the design of this tank. One such problem has been the development of a suitable transmission which would be able to handle the powerful engine used in the vehicle. To this end, the engineering talent of the automotive industry was called into consultation and was asked to cooperate with us. As a result, three different types of transmissions were designed and placed under manufacture. The transmission found by test to be best suited for the strenuous and exacting requirements of the heavy tank will be selected for production.

While there are heavy and supertanks in existence in Europe, there is no vehicle known to exist which would approach the American 60-ton supertank in regard to power of weapons carried and horsepower of engine used to drive it at high speeds across country. The Ordnance Department has maintained in this vehicle the same high horsepower-weight ratio employed in the designs of its light and medium tanks so that the cross-country mobility of the vehicle should in every way duplicate that of the smaller vehicles developed previously.

The two major disadvantages of a supertank are its high cost and its heavy weight with the accompanying difficulty of crossing rivers on temporary bridges. The advantages accruing to the heavy tank are its superior gun power, its heavier armor which makes it invulnerable to all but the most powerful anti-tank guns, and its great crushing power. In some of the important tank battles of the present war, the Germans have used supertanks mainly from the Skoda arsenal at Czechoslovakia as a spearhead of the attack.

The trend of development in tanks at the present time is continuously toward the use of more heavily armored vehicles. As previously stated, there is a distinct limit to the armor plate which can be applied to a given design of tank chassis. It becomes necessary, therefore, if the armor is to be increased materially, to design new vehicles with sufficient horsepower which have all parts proportioned to carry the heavy loads imposed by the thicker armor plate. The supertank which has just been completed by the Ordnance Department is a forerunner of a new line of heavily armored tanks and represents, it is believed, the most powerful tank which has been built in the world up to this time.

PRECISION

that Makes Possible "More Payload per Dollar"

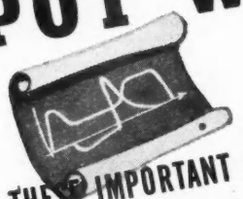
Models 5A43 and 5A430 — choice of overdrive or direct on fifth.

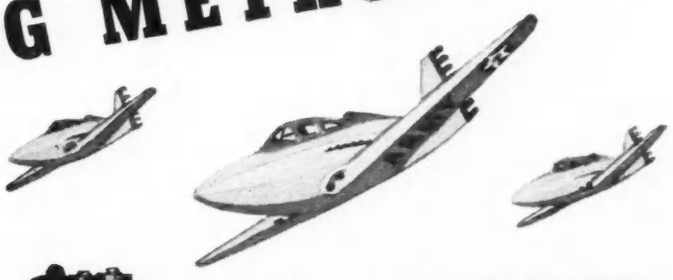
In this multiple boring operation FULLER Transmission cases are bored with four holes simultaneously. Dimensions and locations of the holes are maintained within .001 inch tolerance on the bore and .002 between centers — a precision job calling for the finest of equipment, and the best of craftsmanship.

Through workmanship like this, FULLER builds extra service life — extra dependability into every part of these heavy duty transmissions. That's why FULLER's are rendering such notable service today under conditions that demand the utmost from all trucking equipment.

FULLER MFG. CO. Kalamazoo, Mich.

*SCIAKY PROCESS REVOLUTIONIZES ALUMINUM SPOT WELDING METHODS!





PROVIDES THESE IMPORTANT ADVANTAGES

- Low Current Consumption
- No Special Power Lines
- Sound, Uniform Welds
- Full Automatic Operation
- High Speed Production

The Sciaky Stored Energy Principle and Variable Pressure Cycle enables aircraft manufacturers to replace slow, costly riveting methods with fast, economical spot welding—not only on non-structural parts but also on primary stressed assemblies, thereby greatly speeding up production.

Just two short years ago, the Sciaky Process for welding aluminum and aluminum alloys was introduced to America. As the result of its demonstrated superiority, it has won the enthusiastic acceptance and adoption of practically every important producer of aircraft.

The Sciaky Stored Energy Welding Machine, using only approximately 1/10th the power required by conventional equipment for spot welding aluminum, eliminates disturbing voltage drops and the need for expensive, special power lines capable of handling excessive peak loads.

The Sciaky Variable Pressure Cycle, provides in sequence automatically, a high initial electrode pressure, a reduced welding pressure and a high final forging pressure to restore the original metallurgical characteristics of the welded metal. This process produces welds in aluminum of consistent high quality, superior in strength to riveting, in far less time and at greatly reduced cost.

Small wonder that the Sciaky Process for spot welding aluminum has upset all previous ideas on the subject and bids fair to supplant slower, costlier methods of metal fastenings for all manner of aluminum products, when the war has been won.

Pamphlet describing the Sciaky Process of Electric Resistance Welding mailed free. Use company letterhead, please.

Type PMC02S-16 Sciaky Electric Resistance Welder. Eighty spot welds per minute on two sheets of light alloy of .040" each. Welding capacity: From two thicknesses of .016" each in light alloys up to .091".

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FORD MOTOR CO.
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SCIAKY PROCESS ELECTRIC RESISTANCE WELDING
STORED ENERGY • VARIABLE PRESSURE

Steel and Wood Design for Combat Training Planes

(*Continued from page* 35)

considered, but abandoned because of its low strength-weight ratio.

Tests were then made with SAE 1025 sheet. Although almost three times heavier than aluminum alloy, this steel when heat-treated had a yield point double that of aluminum alloy. Subsequent metallurgical research with other steels, and the cold-rolling of steel at the mill to raise its yield point, eventually gave the aircraft company a practicable low alloy steel with a yield point of 100,000 psi, compared with aluminum alloy's 40,000 psi. Roughly, this means that the steel structure would weigh approximately 12 per cent more than an equally strong structure manufactured from aluminum alloy, as steel weighs 2.83 times as much as aluminum alloy. Since the structural weight of an airplane is only about 25 per cent of the gross weight, by increasing the structural weight 12 per cent, the gross weight is increased only 3 per cent. On the AT-6A this amounted to only 150 lb., well within the AT-6A's authorized overload of 350 lb.

The low carbon, low alloy steel developed for aircraft contains scarcely a trace of carbon and about 2 per cent of alloys. As a comparison, stainless steel contains about 3 per cent carbon and more than 26 per cent of other alloys at the top of the critical list. This low carbon, low alloy steel can be manufactured inexpensively with existing steel production facilities.

From the beginning the steel sheets are treated to prevent corrosion. Before leaving the mill, each sheet is given a light coat of oil. After a given assembly is completed, it is dipped in a wash solution to remove the oil, and then dipped in a weak phosphoric acid solution for a few minutes to give it a permanent protective coating of iron phosphate. Next it is primed and painted in the same manner as aluminum alloy.

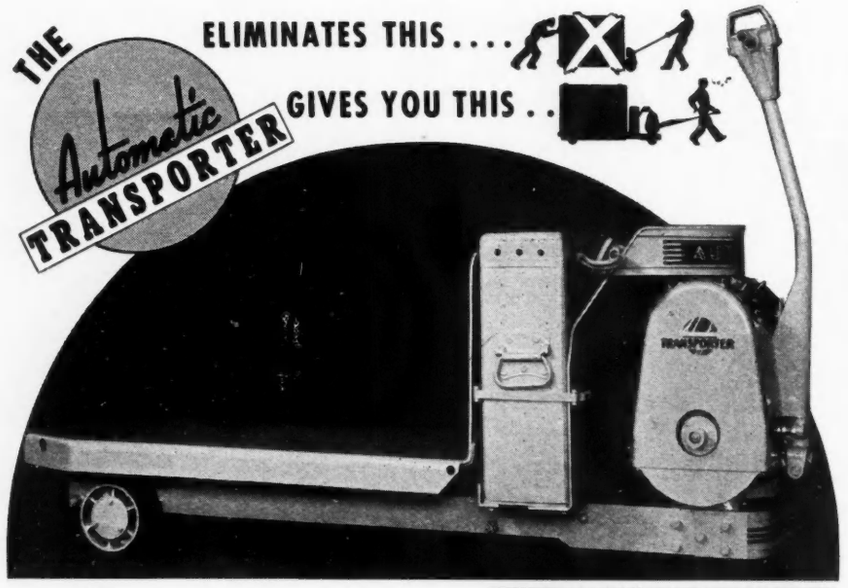
North American engineers are experimenting with a new protective compound which can be sprayed on the sheet steel as soon as it arrives from the mill—a compound which permits spot welding after it has been applied. If it works, North American will cut down production time and expense by eliminating the operation of applying a protective coating after the raw material has been spot welded into assemblies.

It should also be pointed out that the use of steel exterior surfaces may eventually eliminate some of the heavy armor plate used in combat craft, since bullets will glance more readily from a curved steel surface, with its high-penetration-resistant qualities, than from a thicker curved aluminum alloy surface of the same weight per square inch.

Steel sheets used by North American will vary in thickness down to a minimum of .010 in. This minimum thickness is determined partially by strength considerations and partially by other factors, such as cost of manufacture and workability. In like manner, modern aircraft design practice holds the minimum thickness of aluminum alloy sheets to .025 in.

The type of structure used with steel is essentially the same as the normal aluminum alloy structure—a stressed external skin reinforced by transverse internal ribs and bulkheads and by longitudinal "stringers," or drawn strips of metal.

A few of the factors which determine the suitability of steel for this type of structure are shown in the following table:



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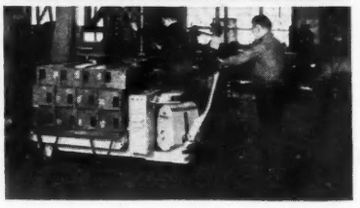
★ FRONT WHEEL POWER DRIVE

★ CONTROLS IN STEERING HANDLE

★ SHOCKLESS HYDRAULIC PLATFORM LIFT WITH EASY FOOT CONTROL



● Think what this means in *safety* for your truckers—*lower* materials handling costs—and *increased* production efficiency

WITHOUT STRAINING—TUGGING—PULLING OR EXTRA PUSHING, THE TRUCKER MERELY WALKS THE "TRANSPORTER" TO ELECTRICALLY MOVE A HEAVY OR BULKY LOAD WITH EASE AND SPEED.

The "TRANSPORTER" combines an efficient foot operated hydraulic lift system with electric power drive and is designed to serve all industry for economical lifting and transporting of various loads of raw materials and finished products on skid platforms up to 6000 lbs. This new lift truck is ideal for buildings where floor loads and elevators have limited capacity

The "TRANSPORTER" is the latest development in lift trucks designed by AUTOMATIC engineers, incorporating many labor-aiding features derived from the knowledge gained through thirty-five years' experience in building Electric Industrial Power Trucks, Tractors and Cranes.

Streamlined in appearance—sturdy in construction—dependable and safe in operation, the "TRANSPORTER" is ready to operate at the trucker's command, forward or reverse, with complete brake and speed control. Just a few movements of the handle, a push of the button and away it goes at safe walking speed. Platform lift is just as easy with foot control. The platform lifts and lowers the load through shockless hydraulic action.

You will want to know more about this "TRANSPORTER"—how it operates and what it can do for you. Write for complete details—no obligation.

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TO GIVE YOU BETTER SPRINGS *Quicker*

THIS girl and her fellow workers at Accurate are "stepping on it" in more ways than one—crowding their machines to produce springs and more springs. It's like that all through the Accurate plant—the only restraining influence on speed is our exacting inspection. We will not push production to a point where it is necessary to sacrifice accuracy and quality.

Here you can be sure of painstaking attention to every requirement of your order—design, materials and delivery! Yes, sir, our motto is: *"step on it"* to give you better springs, quicker. Let's talk it over.

Accurate Springs

ACCURATE SPRING MFG. CO., 3811 West Lake St., Chicago, Ill.

	24S-T Alclad Sheet	Ordinary Low Carbon Steel Sheet	Low Carbon, Low Alloy Steel Sheet
Yield point (psi).	37,000	36,000	100,000
Ultimate tensile strength (psi)..	56,000	55,000	122,000

Not only is the same basic structural design possible with steel as with aluminum alloy, but the same fabricating and forming methods can be used. The Masonite dies and rubber blocks used in aircraft hydraulic presses, the zinc and lead dies used in drop hammers—all can be applied equally well to steel sheets.

Although wood structural parts are a farther departure from conventional aluminum alloy than steel, North American has found that the same basic structural designs can be used with wood as with metal. An example is the monocoque rear half of the AT-6A fuselage, at present an aluminum alloy structure throughout. A test wood fuselage structure was built using thin mahogany plywood for the stressed external covering, and the structures department was asked to put the assembly through the normal load tests given a similar metal structure. They reported "no visible signs of strain at 105 per cent design load" in every test given.

Fir, spruce, birch, and mahogany are the woods which have proved most acceptable in tests conducted thus far, although mahogany will probably be abandoned because it is becoming difficult to obtain. The wood sheets range from 2-ply to 7-ply, and gages used most extensively are between 1/16 in. and 5/32 in.

Major problem encountered in the fabrication of wood parts is the means of fastening pieces together to make an assembly. After extensive tests, during which thousands of specimens were fastened with various glues at varying temperatures and pressures, allowed to set, and then strained to the breaking point in the research laboratory, North American concluded that casein glues were best suited to the requirements. A resinous finish will be applied to all wood assemblies.

Steel used by North American thus far has been obtained from Columbia Steel Co., San Francisco. Most wood assemblies are being furnished by Berkey and Gay, furniture makers in Grand Rapids, Mich. Their interest in the new aircraft market is in charge of Allen Lockheed, formerly one of the original partners in the Lockheed Aircraft Corp.

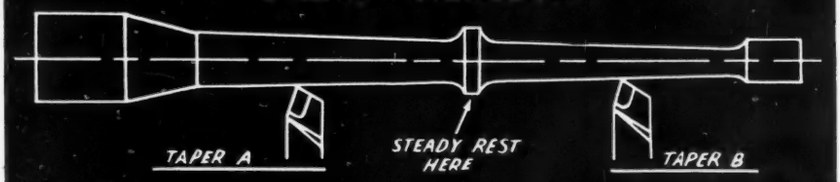
Uniloy Changes Name

The Uniloy Accessories Corporation of Lancaster, N. Y., has changed its name to the Scott Aviation Corporation, according to Earle M. Scott, president of the company.

Begins Bauxite Mining

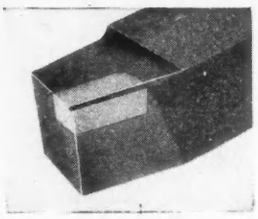
Active mining of domestic bauxite has been commenced by a subsidiary of the Reynolds Metals. Bauxite from Arkansas deposits, now being mined by the Reynolds Ore Company, will be shipped to the Alabama aluminum plant of the Reynolds Metals Co., where it will be refined.

25 MORE GUNS PER GRIND



TAPER A
Tool: 11T70 Grade KM — 15° SCEA — 30° ECEA
Speed: 245 RPM — 210 to 235 FPM
Feed: .0225"/ Rev.
Length of Cut: 28"
Depth of Cut: 1/8"

TAPER B
Tool: 11T70 Grade KM — 15° SCEA — 30° ECEA
Speed: 296 RPM — 158 to 235 FPM
Feed: .0225"/ Rev.
Length of Cut: 34"
Depth of Cut: 1/8" to 3/16" average



Style No. 11

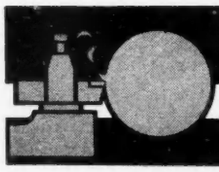
with KENNAMETAL tools

● In finish machining heat treated alloy steel gun barrels, KENNAMETAL Style 11 tools completed an average of 40 pieces per grind, as compared to an average of 15 pieces per grind completed by competitive carbide tools. That fact means KENNAMETAL saved hours of "down time" for the manufacturer, helped him to produce *more* guns *more* quickly.

The superior strength and hardness of KENNAMETAL permit greater machining speeds and removal of more metal between grinds than other carbides. If you machine steels in hardnesses up to 550 Brinell, KENNAMETAL tools can turn "down time" into production time for you.

KENNAMETAL The Accepted STEEL CUTTING CARBIDE

WRITE FOR THE KENNAMETAL VEST POCKET MANUAL



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Foreign Sales: U. S. STEEL EXPORT CO., 30 Church St., New York
(Exclusive of Canada and Great Britain)

MEN & MACHINES

(*Continued from page* 42)

New VAPOpaper

Improved VAPOpaper for better ammonia dry-developed prints announced by The Frederick Post Co., Chicago, Ill.

Rollers for Ammunition Feed

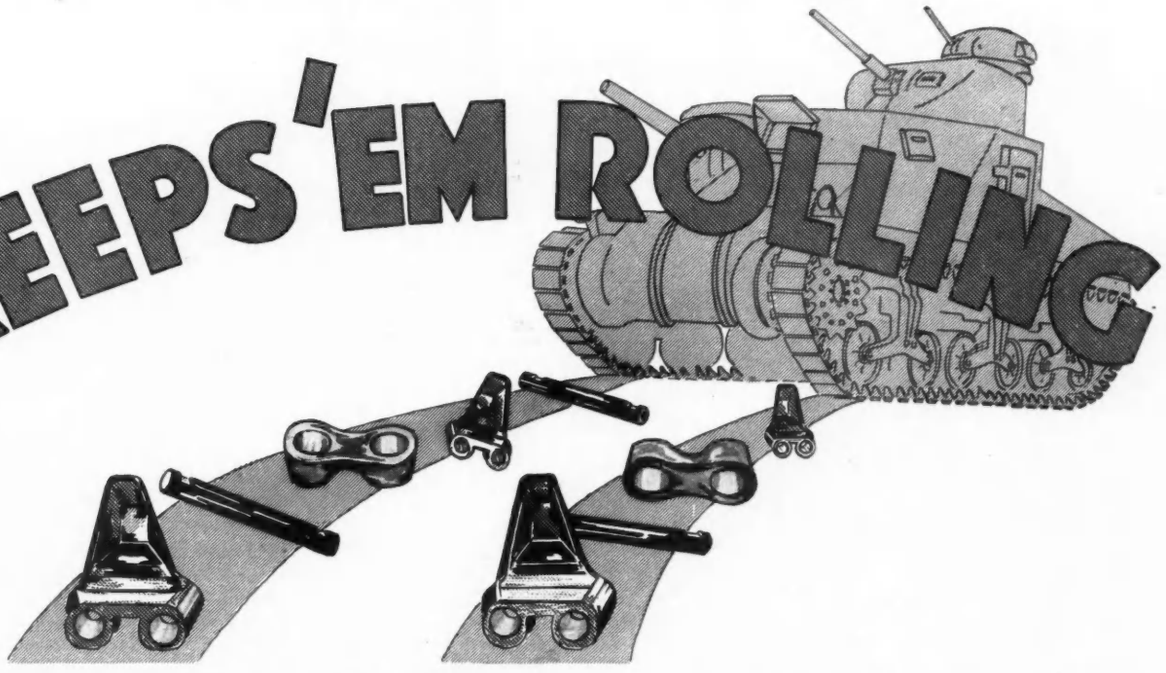
Tenite ammunition rollers for machine gun feed are molded by Columbus Plastic Products, Inc., Columbus, Ohio. Tenite is the product of Tennessee Eastman Corp., Kingsport, Tenn.

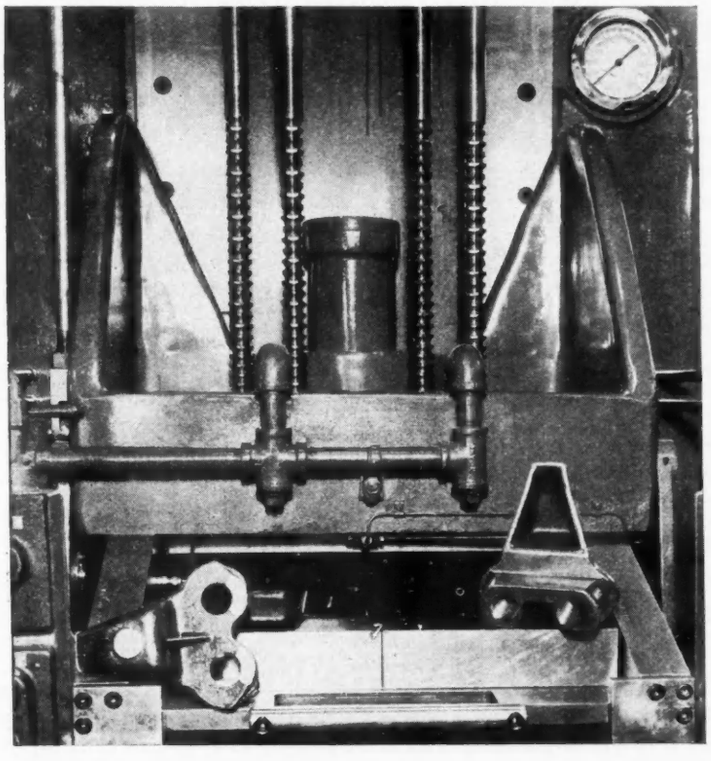
1000-ton Straightening Machine

Press with 1000-ton capacity for straightening shafts up to 18 in. in diameter. Built by Watson-Stillman, Roselle, N. J.

AMERICAN

KEEPS 'EM ROLLING





AMERICAN "Keeps 'Em Rolling" by furnishing equipment for broaching operations on tank track parts.

The close up at the left shows tooling on an AMERICAN VP-4-25 ton 36" stroke vertical hydraulic broaching machine. Operation is broaching two 1⅛" diameter holes 1 13/16" long on 2.500 minus .015 centers through tank end connection of alloy steel. Material removed from each hole is .040 on the diameter. Production obtained is 340 completed pieces per hour.

Identical equipment was also set up for broaching two 1¾" holes 1¼" long in tank track links.

Another tank track broaching operation is done on a special AMERICAN T-6-36 three-way broaching machine. The operation is to broach two flats simultaneously on ends of steel bars for tank track shoes, two different length parts being broached. Production of 300 completed pieces per hour of either part is obtained.

AMERICAN BROACH & MACHINE COMPANY
ANN ARBOR, MICHIGAN, U. S. A.
BROACHING MACHINES, PRESSES, BROACHING TOOLS, SPECIAL MACHINERY

Division of SUNDSTRAND MACHINE TOOL CO. ROCKFORD, ILLINOIS U.S.A.

Problems Presented in the Designing of Six-Wheel Brakes

(*Continued from page* 31)

Thus on an upgrade,

Rear ground pressure =

$$\left(\frac{F}{WB} + \frac{H}{WB}\tan A\right) GVW \cos A$$

Front ground pressure =

$$\left(\frac{R}{WB} - \frac{H}{WB}\tan A\right) GVW \cos A$$

Where

F is the horizontal distance from the center of gravity to the point of contact of the front tires with the road

R is the horizontal distance from the center of gravity to the point of contact of the rear tires with the road

H is the height of the center of gravity above the road

GVW is the gross vehicle weight

A is the grade in degrees from the horizontal

This, of course, is because a part of the weight becomes a force tangential to the tires and parallel with the road surface. To see why this is so it is only necessary to consider that if the vehicle were at a 90-deg. angle grade, there would be no pressure between the tires and the road.

Optimum Braking Distribution

An inconstant position of the center of gravity is unavoidable in highway vehicles and by that token any fixed distribution of braking effort can coincide with the actual distribution of weight only under certain fixed static and dynamic conditions and, therefore, can occur in the operation of a truck only momentarily. It is, therefore, of the greatest importance that the brake engineer select the particular assumed load distribution upon which his brake balance is based with the greatest of care. Obviously he need concern himself solely with conditions existing during brake applications of some severity. Whether he should consider the unloaded condition, normal load, overload or average or mean load is not easy to decide. Certain it is that the greater the severity of braking and the greater the load on any rationally designed vehicle, the greater will be the percentage of load borne by the front axle.

If, therefore, the brakes are balanced for the lightly loaded condition, a mild application will suffice for the maximum retardation and the shortest attainable stop will be made. Now if brakes so balanced are used under a full load or overload, the transfer of weight to the front axle will be materially increased, so that under maximum application the front wheels will not lock before the rear ones do, if at all. This will avoid the hazard of loss of steering control, but maximum retardation will not be reached before the rear wheels lock.

If, on the contrary, the brakes are balanced for the full load condition, the shortest attainable stop will be made with full load. Under light load, however, the transfer of weight to the front axle will be at a minimum and consequently too much braking force will be distributed to the front axle, thus engendering danger of loss of steering control. If the application is restricted to that at which the front wheels will not lock, then the major part of the retardation—that of the rear wheels—will be lost and an excessive length of stop will result.

Three Types Compared

Since six-wheelers particularly are singled out for criticism it is necessary to make some general comparison of the characteristics of the three principal types of commercial vehicles in this re-

fast *and accurate*

Wells SAWS
THE SIGN OF SERVICE

SPECIFICATIONS

WELLS No. 8

Capacity: Rectangle	8" x 16"
(spec. bowed guides)	5" x 24"
Rounds	8" dia.
Speeds: ft. per min.	60, 90, 130
Motor	Specifications optional

WELLS No. 5

Capacity Rectangle (spec. bowed guides)	5" x 10"
Rounds	5" dia.
Speeds ft. per min.	60, 90, 130
Motor	Specifications optional

Accelerate defense production with no sacrifice of accuracy.

The Wells Metal Cutting Band Saw has been designed for todays fast-moving production schedules. It speeds the cutting of almost any metal in a variety of shapes with assured accuracy. Hundreds of duplicates showing a variation of less than .005 inch in thickness are cut speedily without excessive friction and without the use of a coolant. Write today for full information.

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A large stock of blades is available at all times

WELLS METAL CUTTING BAND SAWS

Capable!

...and Loyal. Those who happily number a regal "Great Dane" in their household will say: *"Yes, indeed!"* . . . Nor does this take anything from the amenable, happy disposition of that glorious little Pekinese that is so securely protected by the Great Dane.

You find those qualities in PUSH-PULL CONTROLS, too—Capable, dependable and immediately responsive. It is important, too, that the moving part of a PUSH-PULL CONTROL operates in a bath of lubricant—sealed for life so that no grit or moisture can enter, or lubricant escape. Nothing to rattle. Last long after other controls must be replaced.

Many *important* uses for PUSH-PULL CONTROLS today. Let us discuss their application—deliveries, of course, subject to current regulations.

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AMERICAN CHAIN & CABLE COMPANY, INC.

BRIDGEPORT • CONNECTICUT

spect. For this purpose we may accept as normal or representative the three types compared in the table on page 30.

In the analysis made in the table it will be observed that the two sources of weight transfer have been considered separately and then combined, as reflected in the following formulas, used above:

For weight transfer to front axle:

$$\text{Due to Inertia} = \frac{CGH \times GVW \times BC}{\text{Wheelbase}}$$

$$\text{Due to Brake torque} = \frac{RR \times GVW \times BC}{\text{Wheelbase}}$$

Where

CGH = Height of center of gravity above wheel spindles

GVW = Gross vehicle weight

BC = Braking coefficient in terms of coefficient of tire adhesion equivalent to retardation rate of 14.35 ft./sec.^{2}

RR = Rolling radius of tire

In the case of six-wheelers whose rear brake torque is transmitted directly to the frame, as with four-wheelers, the above equations hold. However, where the rear bogie design is such that the brake torque is balanced out, so that none is transmitted to the frame, the formula for transfer of weight to the front axle, due to brake torque becomes:

$$\frac{RR \times FGW \times BC}{\text{Wheelbase}}$$

Where

FGW = Gross vehicle weight on front axle

The same formulas are used to determine the weight transfer of a tractor-semi-trailer by solving separately for the semi-trailer and the tractor, as though the fifth wheel were the front axle of the semi-trailer. In so doing, it must be understood that the effective center of gravity on the tractor will be the combined centers of the tractor alone and the fifth wheel trunnion (which is the center of gravity of the dynamic weight imposed on the tractor by the trailer). Accordingly, the formulas for the tractor-semi-trailer are:

For semi-trailer weight transfer to fifth wheel:

$$\text{Due to Inertia} = \frac{CGH \times GWT \times CB}{AK}$$

$$\text{Due to Brake torque} = \frac{RR \times RGW \times BC}{AK}$$

Where

GWT = Gross weight of trailer

AK = Axle to kingpin dimension

RGW = Gross weight on trailer axle

For tractor weight transfer to front axle:

$$\text{Due to Inertia} = \frac{HCG \times TGW \times BC}{\text{Wheelbase}}$$

$$\text{Due to Brake torque} = \frac{RR \times TGW \times BC}{\text{Wheelbase}}$$

Where

HCG = Height of combined centers of gravity of tractor alone and fifth wheel trunnion

TGW = Total gross weight of tractor plus the sum of the static gross weight of trailer imposed on fifth wheel and the weight transferred thereto by inertia and trailer brake torque

The authors are aware that in the above calculations of weight transfer due to mass inertia, a departure has been made. It is customary to consider the points of tire contact with the ground as the pivot points about which the mass centered at the center of gravity gyrates. However, it is believed to be more correct to separate the simple inertia transfer from that caused by torque reaction. So considered, it is the spindles which become the pivot points, as they certainly are with respect to the torque moments from the brakes.

In explanation of the market difference in center of gravity height as between the straight trucks and the semi-trailer, it should be noted that some of this is accounted for by the relative lightness of the semi-trailer chassis as compared with those of the straight trucks and also that the centers as given in the table are those above wheel spindle height and not as usually given,

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above the road level. In the case of the tractor-semi-trailer, these formulas have been used separately for the trailer and then, using the transferred load at the fifth-wheel trunnion, they are used for the tractor.

A different method has been used by Heldt* in analyzing weight transfer of a tractor-semi-trailer, in that the two components of weight transfer, namely, mass inertia and brake torque are not separated, the pivot points are assumed to be the points of tire contact with the ground and that kingpin offset has been ignored.

In view of the above, showing that of the three types, the six-wheeler evinces neither the greatest nor the least variation in front-wheel loading and that, therefore, it should offer little difference in its potentialities for front-wheel retardation without risk of loss of steering control, it must be concluded that the complaints on this score are based if at all upon something other than dynamic weight transfer.

* "Transfer of Load Due to Braking in Tractor-trailer Combinations" by P. M. Heldt—AUTOMOTIVE INDUSTRIES, December 15, 1941.

Steering Reluctance of Bogie

The reason the problem is so acute with six-wheelers is that the supposedly rigid alignment of the rear bogie wheels constitutes a resistance to steering and that, therefore, any tendency for the front wheels to lose traction is of graver concern than with either a four-wheel truck or tractor-semi-trailer.

This is the crux of the six-wheel steering problem so far as brakes are concerned. In the Pacific Coast States many operators have attempted to solve the problem by eliminating front-wheel brakes on six-wheelers, advancing the excuse that as not over 15 per cent of the braking is on the front wheels of a six-wheeler, this may be sacrificed for the sake of safety.

Makers of brake equipment have come forward with another solution in the shape of the limiting valve. This valve serves to reduce the distribution of line pressure to the front wheels, so that full braking effect may be provided for the fully loaded condition and this reduced when under partial or no load for the sake of safety.

While we must accept as a fact the existence of a problem with respect to the steering control of many six-wheelers now operating on the highways, we must not conclude from this that this trouble arises from an inherent defect. It must be remembered that many six-wheelers are adaptations of four-wheeled vehicles, to which attachment third axles have been applied or which have merely had a four-wheeled rear bogie substituted for the standard rear axle with little or no change in the front brakes.

For six-wheelers a relay valve to speed up the application of the rear brakes and a quick-release valve for the fronts seems essential, while as observed above, brake distribution quite different from that required for four-wheel trucks is clearly indicated.

Need for Brake Engineering

It thus becomes a strong probability that where six-wheeled trucks have been engineered as such in their brake distribution and air schedule, and in view of their normal weight-transfer characteristics, much of the over-application of front-wheel brakes should disappear. With a limiting valve, adjusted in accordance with the load, the condition of the road and according to whether the gradient is up, down or neutral, a very high degree of exactitude in brake distribution can be achieved.

The one question remaining is that of the rear bogie's reluctance to steering. That this is pronounced in short-wheelbased C.O.E. types and in tractors is undeniably a fact; but in the long wheelbased types used in long-distance freighting, the longer lever arm through which the front wheels operate in relation to the bogie should easily overcome this reluctance.

Some Bogies Self-Steering

Furthermore, the assumption that a bogie necessarily resists steering is not warranted. It is perfectly true that

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when horizontal radius rods or reach members are used to align the axles, they will be held in parallelism, but with oblique radius rods or with positively cambered springs in lieu thereof, there is a positive steering action within the bogie itself.

Fig. 1 illustrates the action of a bogie of the latter class. Here it will be seen that when proceeding on a straight course, the two axles are parallel, but that when rounding a turn, centrifugal force will tend to shift the center of gravity outwardly, thus causing the outer spring to deflect and the inner one to retract. The positive camber causes a corresponding elongation of the outer spring and shortening of the inner, thus producing a positive steering effect. It has been found that this effect is so pronounced in some vehicles that the ease and positiveness of steering is of a high order.

Tire Wear

It may be noted in passing that this steering action, inherent in some bogie designs explains why tire wear experience with six-wheels is subject to considerable variation. In those bogie types in which the axles are constrained by their radius rods or reach members to constant parallelism, there must be considerable scuffing on turns, whereas this is largely missing in types having a more elastic relationship between the axles.

Turning Radius

While on this subject of steering, there is another misconception respecting six-wheel characteristics that might as well be cleared up. Because of its articulation, the tractor-semi-trailer is unquestionably capable of maneuvering in closer quarters than the rigid six-wheeler, despite its greater overall length for the same load platform length. From this it is often assumed that the six-wheeler is at a disadvantage in negotiating tortuous highways. The facts are, to the contrary, that while the tractor-semi-trailer by reason of the shorter wheelbase of both the tractor and trailer, is able to turn in a shorter radius, it also requires a greater width of road in which to make a turn.

Bogie Hopping

Bogie hopping, as in the case of steering stability, is affected by weight transfer. In the latter we are concerned with the transfer between the bogie as a whole and the front axle, resulting from the inertia of the mass of the whole vehicle acting through the center of gravity. In the former, however, we must deal with forces acting within the bogie itself. These are concerned with inertia forces acting upon the two axles through the trunnion and in addition with the torque reactions of the axles.

There are two types of bogie construction on six-wheeled trucks, namely, the four-wheel-driven type and the two-wheel-driven type. In the former, it is customary to place the trunnion midway between the axles to effect even distribution of static weight between them. In the latter type, slightly more weight is imposed upon the driving axle than upon the trailing one—usually about 55 per cent and 45 per cent, respectively.

Obviously, for proportionate braking in the latter case, it is essential that slightly greater braking force be exerted on the brakes of the driving axle than on the trailing axle. In the case of the four-wheel-driven bogie, however, it would at first seem that the braking force applied to each axle should be the same.

Torque Reaction

This is so, however, only if the dynamic loads remain balanced in the same manner as the static loads. Unfortunately, in many types of bogie design, this is not realized. The reason is found in torque reactions from the axles to the frame and in the couple between the trunnion and the axle spindles, where the trunnion height is above the spindle height.

Bogie suspensions divide themselves into four general groups with respect to their torque reactions:

1—Those having a pronounced tendency to transfer weight from axle to

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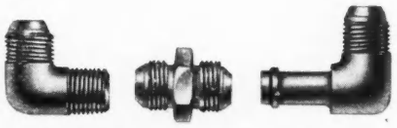
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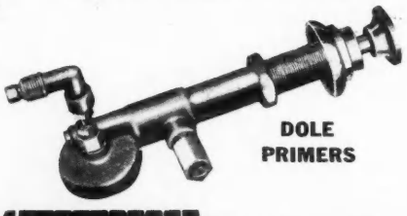
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axle as well as a considerable torque moment on the frame.

2—Those having a definite tendency to transfer weight between the axles but little or no torque moment on the frame.

3—Those having little or no tendency to transfer weight between axles, but still exert a torque moment to the frame.

4—Those having little or no tendency toward either.

In the fourth class is the construction shown in Fig. 2. This is a simplification of the parallelogram arrangement, in which the springs themselves serve as the lower torque rods, so that only the single upper set at the center of the frame are used. Twisting of the springs is eliminated entirely by the use of rubber shock insulators as the means of attachment of the springs to the axles. It will also be noted that the trunnion is located below the level of the wheel spindles, so that the slight torque moment on the frame due to the torque rods is balanced by the opposing inertia force acting through the trunnion. This is the type of bogie assumed in the foregoing study of inertia weight transfer, in which all brake torque effect from the rear bogie was assumed to be absent.

Reverting to that study, it will be observed that the effect of brake torque upon load transfer is serious and present in both four-wheeled truck and four-wheeled tractor types. If the six-wheeler be equipped with a bogie which transfers any considerable amount of brake torque to the frame, then it, too, may overload the front axle well beyond its prudent braking capacity, thus reducing the overall brake effectiveness. However, since bogie constructions do exist which practically nullify torque reaction upon the frame, it will be evident that six-wheelers so equipped should, as they do, offer perhaps the closest approach to uniformly high, controllable brake ability.

Effect of Inter-axle Differential

Four-wheel-driven six-wheel bogies are made both with and without inter-axle differentials. It is not generally thought that this difference is of importance as effecting brakes, but a little reflection shows that dependent upon the bogie construction, this difference may be important. Were there no differential action whatever, either between axles or between the wheels on each axle, then a single brake, acting anywhere on the system would have equal effectiveness to the conventional four-wheel brakes and unbalanced braking would be impossible. It would prevent the sliding of a wheel on a slippery spot unless all wheels slide at once, and in the case of a bogie suspension which failed to preserve equal distribution of weight between the axles, it would prevent the locking on the light axle, while the wheels on the heavy one continued to turn. However, in such case the loads imposed upon the axle shafts would rise to four times normal while those on the driving gears and inter-axle driveshaft would be doubled. Other objections, of course, would be resistance to steering, inter-axle and inter-wheel fight, excess scuffing of tires and power-wasting frictional drag.

When only the inter-axle differential is omitted, quite different effects upon braking are produced. The locking of one wheel acts through the axle differential to speed up the opposite wheel. This acceleration is resisted by its brake and so a retarding force reacts through the solid inter-axle shaft upon the other axle. However, as both axles are constrained to turn at the same speed, a disproportionate amount of work will be done by the wheel opposite the slipping one. Indeed, this wheel may actually be accelerated slightly, thus reducing the total retarding force.

With three differentials, the loss of traction by any one wheel, upon a severe brake application, results in the locking of that wheel. This, in view of the forward travel of the vehicle tends to speed up the opposite wheel, which acceleration is resisted by its brake, thus tending to slow down that axle. This slowing down of one axle, acting through the inter-axle differential, then, tends to speed up the other axle, thus increasing the work to be done by its brakes. Thus, to some extent the loss

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of energy absorption on the wheel losing traction is made up for by increased friction on the other three.

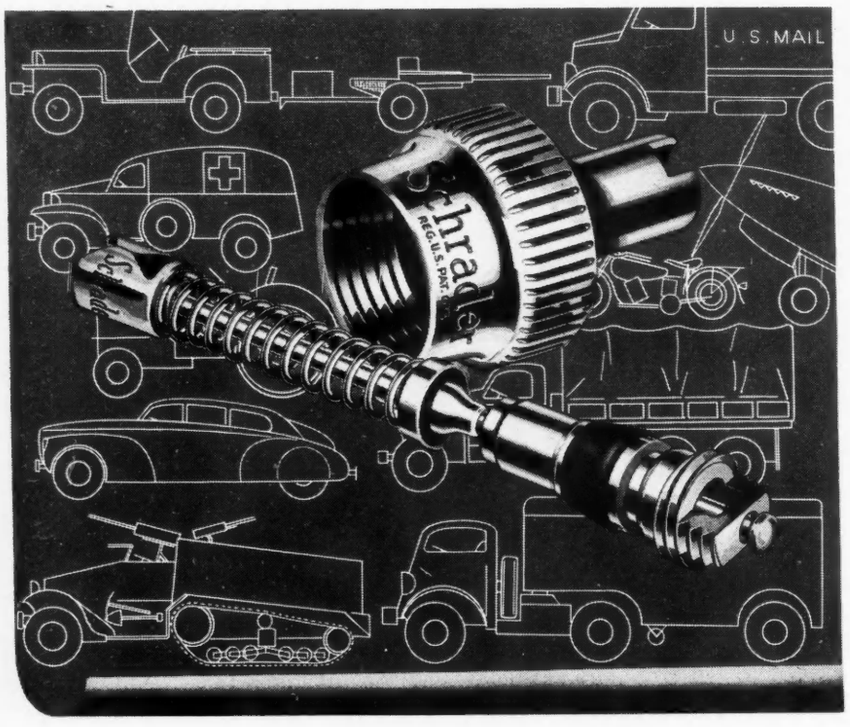
Due to the action of the inter-axle differential, each axle may find its own balancing speed and hence the work done by the three effective brakes will be equalized with the minimum loss of total braking force.

Differential Types

One of the objections to third differentials, of course, regardless of their benefits to braking, is their effect upon driving traction. Straight differentials, such as universally used in axle carriers, have the unfortunate property of transmitting motion along the line of least traction resistance. This is tolerable where but two wheels drive, but with four driving wheels, three such differentials make traction uncertain.

This has given rise, during the past 30 years and more to the invention and promotion of scores of self-locking or semi-self-locking differentials, ranging all of the way from simple ratchet devices up to adventures in unorthodox gearing. The great trouble in the past has been that if the device were a true differential, it depended upon friction or inertia for its locking or semi-locking action. The former was wasteful of power and tended to become ineffective as the rough surfaces became polished. Another type which has had considerable vogue employs a varying pitch-line on an otherwise conventional appearing bevel gear design to impart alternately favorable and unfavorable leverages to the two sides to gain considerable immunity to wheel spinning. This type, in common with the inertia type, however, suffiers the drawback of severe vibration—particularly when used in the high-speed inter-axle location and intermittent torque.

A non-spinning differential which provides a positive and limited torque bias toward the side having traction and wholly free from these objections, operates on a cam-and-plunger principle, providing true differential action at all times, with steady, continuous torque and no end-thrust whatever. This device proves wholly adequate for highway work when used purely as an inter-axle power divider. For the more severe classes of work it may be used in all three places.



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(*Continued from page* 25)

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Camshaft, subsidiary drives, water pump and all other bearings	3
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All bearings	3
Transmission (Gear-sets)	
All bearings	3

When a group number is approved by the Ministry of Supply it represents the maximum percentage of tin permissible, and users are expected to employ the lowest tin content of the group, if practicable, and if possible, to use a lower group. Irrespective of the classification, a user must not employ for any specific application an alloy of higher tin content than has been his practice hitherto. The use of solid cast unbacked bearings is prohibited and must be discontinued in favor of backed bearings with thin linings.